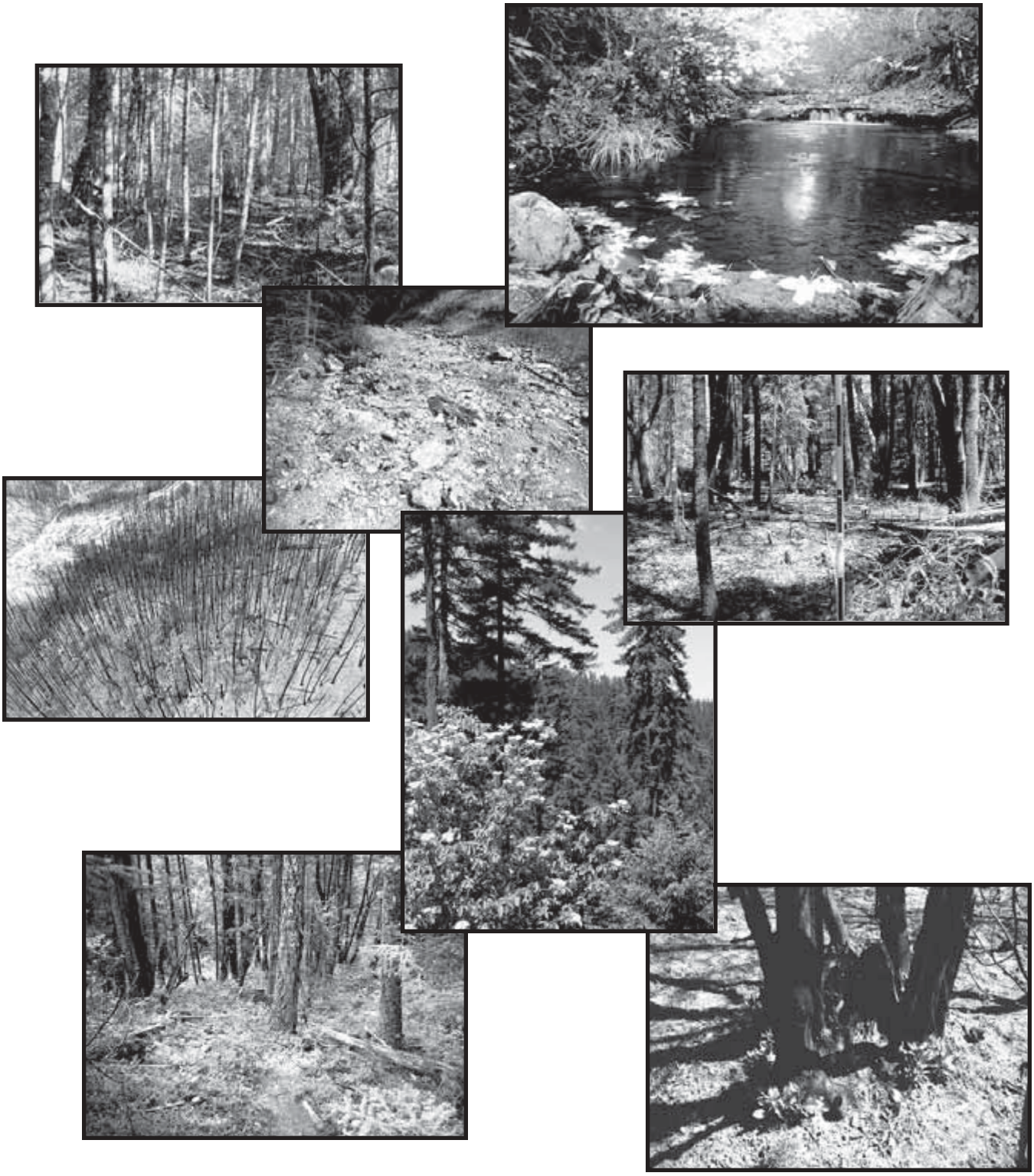
Chapter 3
Affected Environment and Environmental Consequences



Changes Between the Draft and Final EIS

The following changes were made to Chapter 3 between the Draft and Final EIS. Minor corrections, explanations, and edits are not included on this list.

- Cumulative effects discussions throughout the chapter were clarified and/or strengthened.
- Section 3.4.2.1 was updated to include functioning condition of streams.
- An Aquatic Conservation Strategy consistency determination discussion was added to Section 3.4.3.3, Hydrology.
- Map 3-6, showing Riparian Reserves, proposed riparian restoration projects, and research salvage units was added to Section 3.4, Hydrology.
- The Special Habitats (Section 3.7), Special Status Plants (Section 3.8), and Noxious Weed (Section 3.9) narratives were rewritten for clarity.
- Section 3.7.2.1 updated Riparian Reserve acres based on 2003 stream surveys.
- Section 3.8.2.1, Special Status Plants, added information on vascular plants surveys conducted in proposed area salvage units for Alternative G.
- Section 3.10.3.1, Fire and Fuels, added fuel loadings by size classes to direct and indirect effects analysis.
- In Table 3.12.1, PIF focal species were replaced with the USFWS Species of Concern list for Medford BLM to focus on land birds of specific concern for southwestern Oregon.
- In Section 3.12.2.1, Wildlife, Red Tree Vole surveys were completed in proposed FMZs and the analysis was updated.
- Additional information on cavity nesters was added to Section 3.12.2.2, Wildlife.
- Section 3.12.3 was updated to include post-burn occupancy information from 2003 Northern spotted owl surveys
- Section 3.12.3.1 added explanation about the need to survey or when surveys would not be needed for Great Gray Owl and goshawks.
- The conclusion in the DEIS under Alternative G, Section 3.12.3.2, that snag levels do not meet DecAID was in error. This was changed to reflect the fact, based on information presented in Appendix D, that snag levels do fall within the DecAID recommendations under Alternative G.
- Section 3.15.2, Cultural Resources, was updated to include information on cultural resource inventories completed within the fire perimeter.
- Discussion was added to Section 3.17.3, Economics, to identify differences in volume estimates if research units were salvage logged using DecAID criteria.

3.0 Affected Environment/ Environmental Consequences

3.1 Introduction

- In July 2002, 982 fires were reported in Oregon and Washington.
- The Timbered Rock Fire burned 27,100 acres between July 13 and August 9.
- Lands within the project area are designated as Late-Successional Reserve, Riparian Reserve, Key Watershed, Deferred Watershed, and Paired Watershed.
- Relevant resources affected by the alternatives, found in the project area, are discussed.
- For each resource, the existing pre- and post-fire environments are described.
- After each resource's affected environment description, the impacts of proposed salvage and restoration in each alternative are analyzed under the same resource heading.

3.1.1 Incomplete or Unavailable Information

There is less than complete knowledge about many of the relationships and conditions of wildlife and plant species, forest habitats, the economy, and rural communities. The ecology, inventory, and management of large forests is a complex and developing discipline. The biology of specific species prompts questions about population dynamics and habitat relationships. The interaction among resource supply, the economy, and rural communities is also an inexact science.

The EIS Team examined the data and relationships used to estimate the effects of the alternatives. There is a substantial amount of credible information about the topics in this environmental impact statement; the relationships and basic data are well established. The best available information was used to evaluate the options and alternatives.

When encountering a gap in information, the question implicit in the Council on Environmental Quality (CEQ) regulations on incomplete or unavailable information was posed: Is this information "essential to a reasoned choice among alternatives?" [40 CFR 1502.22 (a)]. While additional information would often add precision to estimates or better specify a relationship, the basic data and central relationships are sufficiently well established. Any new information would be unlikely to reverse or nullify these relationships. Though new information would be welcome, no information was determined to be missing which would be essential to a reasoned choice among the alternatives as they are constituted.

New information derived through the research proposed in this Draft EIS would have long-term implications and will not be available to influence decisions made through this analysis.

3.1.2 2002 Regional Fires

The 2002 fire season was a difficult one for wildland firefighters. Colorado (Hayman Fire), Arizona (Rodeo/ Chediski Fire), and Oregon (Biscuit Fire) each had the largest wildfire in that state's recent history. On a national basis, over 68,500 fires burned 6.7 million acres – double the 10-year average. More than 110,000 structures were threatened with 98 percent saved. National fire fighting organizations went to fire preparedness level 5 (the highest rating) five weeks earlier than ever before and stayed at that level for a record 62 days.

Over 28,000 firefighters and support personnel participated in fire fighting activities in 2002. In addition, 600 US Army personnel and 950 international firefighters provided assistance. On a personal level, there were 21 fatalities within the wildland fire fighting community.

A record-setting heat wave gripped much of California, the Great Basin, and the Pacific Northwest between July 7 and July 14. Record high temperatures were set or matched in about three dozen western locations between July 10 and July14. More than 500 daily record highs were established during this 8-day period. Oregon records were set in Burns (106 degrees on July 11 and 107 degrees on July 12), Monument (112 degrees on July 10), Paisley (102 degrees on July 11), and Enterprise (108 degrees on July 13).

During this time, the national resource commitment, including Pacific Northwest resources, was 178 hand crews, 348 engines, 93 helicopters, 4 Type I overhead teams, and 10 Type II overhead teams. Resources available in the Pacific Northwest included 4 of 11 interagency hotshot crews, 4 of 9 heavy air tankers, and 18 of 55 smokejumpers.

On July 12, 2002, the Northwest Coordinating Center issued a report indicating drier than expected conditions, particularly at mid to lower elevations east of the Cascades and in Southwest Oregon. Many units reported continued drought-like conditions, dry soils, low moisture levels in live woody and herbaceous fuels, and low stream flows. These conditions contributed to fires burning through areas of live

vegetation. That same day, the National Weather Service issued a "red flag warning" for southern Oregon and eastern Washington for dry thunderstorms, high temperatures, low relative humidity, and high Haines index. The Haines index is a measure of atmospheric stability. A high Haines index corresponds to a higher wildfire growth potential. There is a strong correlation between atmospheric stability and wildfire growth potential.

The State of Oregon had 361 fires in July. Five became large fires or fire complexes in the Southwest Region (Timbered Rock, Lost Lake, Roseburg, Squires Peak, and Wall Creek). The latter two fires were located within the wildland urban interface and threatened numerous homes. From July 12 to 15, over 15,000 lightning strikes were recorded in Oregon and Washington. Between July 12 and July 15, 375 new fires were reported with 16 becoming large fires or fire complexes. Federal agencies reported 246 fires in July, with approximately 240 of these occurring between July 12 and July 15. Four of these became large fires (North Umpqua, Tiller, Biscuit, and Florence).

In July 2002, 982 fires were reported in Oregon and Washington. This is 157 percent of normal. Forty-three fires became large fires or fire complexes. The average number of large fires for July is 18. The Pacific Northwest normally has one lightning episode in July but, in 2002, there were three.

In Oregon, an unusual number of large fires occurred. These included Monument, Malheur Complex, Flagtail, and 747 in northeastern Oregon. The Winter, Tool Box, Grizzly, Lava, and Skunk fires were located in south central Oregon. Finally, large fires in southwest Oregon included North Umpqua, Roseburg, Squires Peak, Wall Creek, Lost Lake, Tiller Complex, Biscuit (including Florence), and Timbered Rock. This extremely high fire occurrence, not only on a national basis but also in the Pacific Northwest, placed a heavy demand on the availability of fire fighting resources.

3.1.3 Timbered Rock Fire

On July 13, an evening lightning storm hit Jackson County, starting 34 fires in the Oregon Department of Forestry-Medford Unit and 23 in the Rogue River NF. Three fires within the vicinity of Timbered Rock were not detected until July 15. On the afternoon of July 15, a retardant drop was requested by a Rogue River NF initial attack crew working on the Hawk Mountain Fire. The tanker pilot reported another fire about one-half mile to the west. This came to be known as the Timbered Rock Fire.

Crews from the Rogue River NF were successful in controlling the Hawk Mountain Fire plus another fire about one mile to the west. Both fires were contained at less than one acre. However, the Timbered Rock Fire, located in much rougher and more isolated terrain, proved more difficult to control.

The point of origin was located at a spot where Rogue River NF, Umpqua NF, and BLM-administered lands converge along the Rogue-Umpqua Divide. It was originally thought the fire started on lands where either the Umpqua NF or Douglas Forest Protection Association (DFPA) had control responsibility. However, the Umpqua NF was fighting a number of other fires and had an understanding with the Rogue River NF that the Rogue River NF would handle fires along the divide. At some point during the initial stages, the DFPA was notified and took action to open a road to the west of Timbered Rock. The Rogue River NF continued to provide initial attack. On Monday, July 15, the ODF was notified by the BLM of the occurrence of three to four fires in the Timbered Rock area and that Rogue River NF was responding. The ODF top priority was the Squires Peak Fire, located within the wildland urban interface. The ODF also had local fire fighting teams on Horse Mountain, Wall Creek, Neil Rock, Lost Lake, and Sweet Meadows fires.

Around 12:30 pm on July 16, the fire was about one-fourth acre in size. At about 9:15 pm, a field observer reported three separate smoke columns just below the fire. On July 17, three retardant drops and two helicopter water bucket drops were made. The fire was lined on two sides but not along the bottom due to compromised firefighter safety from burning snags and debris rolling down hill. This debris started new fires below the hand crews as they tried to build a fireline downhill. Resources assigned to the fire included one 10-person crew, one 20-person crew, a faller, and a field observer. The Timbered Rock Fire was approximately 5 acres in size.

On July 18, efforts to control the Timbered Rock Fire continued. About 1:00 pm, it was reported the flanks of the fire were actively burning downhill. If these fingers of fire merged, the fire would be about 15 acres and would involve BLM-administered lands, private lands, and Umpqua NF lands. In the afternoon, the ODF and Rogue River NF agreed to pass control of fire fighting efforts to ODF, who has overall responsibility to fight fires on BLM-administered lands. BLM and FS personnel prepared a "wildland fire situation analysis" as the Rogue River NF relinquished control of the Timbered Rock Fire. Resources assigned to the fire remained much the same.

During evening coordination meetings (which included all major land owners) at the local ODF office, resource allocations and priorities were established for fire fighting efforts. Fires in the wildland urban interface remained top priority, which included Squires Peak, Sweet Meadows, Neil Rock, Berry Rock, and Wall Creek. The Timbered Rock Fire remained at the bottom of the priority list.

On July 19, control of the fire was assigned to the ODF. Fire size was reported at 26 acres. Resources assigned included an Incident Commander from ODF, a task force leader, two 20-person crews, one tender, and two field observers. Three

helicopters also provide assistance. Concerns over firefighter safety remained high because of steep, rugged terrain and lack of safety zones and escape routes. Additional resources were assigned on July 20 and 21. These resources became available after being released from other fires.

On July 22, the size of the fire was reported to be 39 acres in the morning and 66 acres in the evening. At 11:47 am, a support helicopter crashed into the canyon below Timbered Rock. At 12:41 pm, suppression personnel left the fireline to assist with patient evaluation, triage, and extraction. On July 23, the fire hit the bottom of the draw and became a major fire. On July 24, the fire grew from 161 acres in the morning to 1,500 acres at dark. From the evening of July 23 to August 5, 14 days, the Timbered Rock Fire expanded from 161 to 27,090 acres. The Biscuit and Tiller fires also blew-up during this same time period.

The progression in the size of the Timbered Rock Fire from July 13 to August 9 is shown in Figure 3.1-1.

The fire was declared contained on August 9 at 6:00 pm. Control was declared September 14, 2003, when mop-up objectives were met inside the perimeter. The interior was expected to smolder late into winter. The final fire size was 27,100 acres (see Map 3-2b, Timbered Rock Fire Progression).

3.1.4 Reasonably Foreseeable Cumulative Effect Considerations

The EIS Team used the following information to estimate effects on a cumulative basis. Information was gathered primarily from landowners or administrators. Anticipated actions described below would be the same across all alternatives. The following is correct as of November 2003.

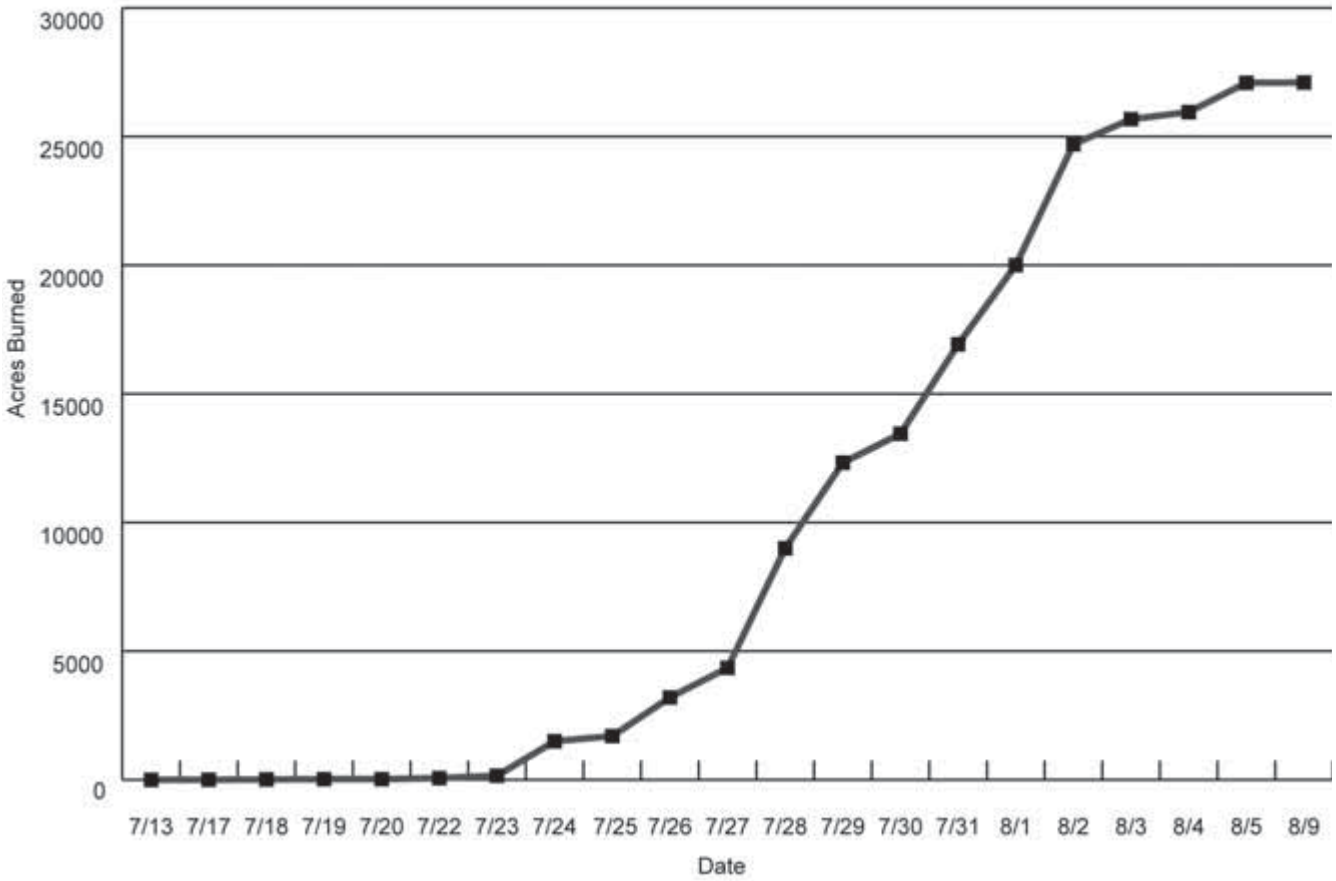
3.1.4.1 Fire Suppression Activities

A total of 63.2 miles of control lines were used throughout the Timbered Rock Fire: 22.6 miles of tractor line, 30.8 miles of existing roads, and 9.8 miles of hand lines. Of that, 20.1 miles of control lines were constructed on BLM-administered lands. All control lines were rehabilitated to contract standards or better. There were a total of 16 retardant drops over 5 days within the Timbered Rock Fire, using about 38,800 gallons of slurry.

3.1.4.2 U.S. Army Corps of Engineers (USACE) Lands

The Timbered Rock Fire burned 611 acres of USACE lands. Approximately 221 acres burned at high or moderate severity would be replanted. Some salvage is being considered. Areas damaged as a result of fire suppression actions were

Figure 3.1-1. Timbered Rock Fire Progression



rehabilitated. Roadside hazard reduction would proceed as necessary.

3.1.4.3 Rogue River National Forest Lands

The Timbered Rock Fire burned 2,647 acres of Rogue River NF lands. Per discussions with the Prospect District Ranger, no salvage is anticipated. Areas damaged as a result of fire suppression actions were rehabilitated.

3.1.4.4 Umpqua National Forest Lands

The Timbered Rock Fire burned 84 acres of Umpqua NF lands. Areas damaged as a result of fire suppression actions were rehabilitated and no salvage is anticipated.

3.1.4.5 Forest Management on Industrial Forest Lands

Approximately 11,140 acres of industrial forest land burned at various levels. Of those, about 5,725 acres are proposed to be harvested in 2002 or 2003: 410 acres would be helicopter logged, 3,255 cable logged, and 2,060 tractor logged. About 1,050 acres were planted in 2002 with another 6,625 to be planted in 2003. Seven miles of new road would be built. Herbicides (Oust and 2,4-d) were aerially applied to 255 acres, Atrazine was backpack applied to 221 acres, and Atrazine will be aerially applied to another 6,000 acres in 2004. Logs were placed in 2½ miles of fish stream, some snags were left for wildlife, check dams were installed in drainages and along roads above culverts, and firelines were water barred. Skid trails and logging corridors were water barred and debris scattered on them. Gates were installed to control traffic during logging operations and restrict traffic on unsurfaced roads.

3.1.4.6 Tiller Complex and Apple Fires (2002) within Umpqua NF

Two salvage EISs would be prepared in 2003 addressing salvage on Matrix lands. The volume is estimated to be 20-80 MMBF. Salvage in portions of the LSR burned in 2002 would be analyzed in a separate EIS. Roadside hazards would be reduced as necessary.

3.1.4.7 Wall Creek Fire (2002)

Wall Creek Fire was located in the adjacent Trail Creek drainage. A total of 313 acres burned with 150 acres of high and moderate burn severities. Industrial forest lands were already harvested and planted. The Trail Creek EA reevaluated 216 acres of BLM-administered land and about 16 acres are proposed to be helicopter logged as part of Trail Creek timber sales. Harvest could occur in 2003. Firelines on BLM-administered lands were water barred, reseeded with native grass seed, debris pulled back on firelines, and straw mulch applied within 150 feet of streams.

3.1.4.8 Trail Creek EA for Timber Harvest and Hazardous Fuels Reduction

Timber harvest and hazardous fuel reductions in adjacent Trail Creek would occur as proposed in the Decision Record. Of 1,561 acres proposed for timber harvest, 573 would be tractor logged, 215 cable logged, 716 helicopter logged, and 57 bull-lined from existing roads. Hazardous fuels would be reduced on 1,311 acres. Proposed road projects include: 32.2 miles of road improvement or renovation, 1.5 miles of new temporary road construction, 16.6 miles of seasonal or temporary road closures, 9.4 miles of fully decommissioned roads, and 5.5 miles of partially decommissioned roads. Four pump chances would be improved and 30 helicopter landings used. Within Riparian Reserves, 157 acres would be thinned, 328 acres would be treated for hazardous fuels, 3.0 miles of roads would be fully decommissioned, 1.0 mile partially decommissioned, 14.0 miles improved or renovated, 4.0 miles temporarily closed, and 1 culvert would be replaced to improve fish passage.

3.1.4.9 Proposed Flounce Around Timber Harvest and Hazardous Fuels Reduction

Timber harvest and hazardous fuel reduction projects presently being proposed on Matrix lands in the adjacent Lost Creek Watershed by BLM: regeneration harvest on about 45 acres leaving 16-25 trees per acres, select cut 247 acres, and thin 251 acres. Harvest systems anticipated include 33 acres of cable logging, 134 acres of helicopter logging, and 439 acres of tractor logging. Approximately 2,350 acres would be treated for hazardous fuels reduction and about 500 acres treated within the timber sale units.

3.1.4.10 Other Considerations

The proposed Elk Creek Dam will continue in an unknown and unsettled state. Trap and haul of coho salmon will continue into the foreseeable future.

No cumulative effects from the Biscuit Fire were identified because of the distance between the Timbered Rock and Biscuit fires.

No cumulative effects associated with other smaller fires (2001 and 2002) within the general geographic area were identified because of location and size, including Horse Mountain, Sweet Meadow, Berry Rock, Lost Lake, Squires Peak, Quartz Mountain, East Antelope, and numerous other smaller fires. Also, no additional cumulative effects associated with fire were identified in 2003 as no fires occurred in the general geographic area.

The existing Lost Creek, Bieber-Wasson, and Lower Big Butte Creek timber sales and hazardous fuel treatments on BLM-administered lands on the south side of Lost

Creek Lake and the Rogue River would not contribute to cumulative effects for these project proposals.

The Mill Creek project, covering about 6,300 acres on the Rogue River National Forest, is located far enough away so it would not contribute to cumulative effects for these project proposals. Projects include commercial timber harvest, density management of overstocked stands, density management of non-commercial stands, road decommissioning, prescribed burning, and hazardous fuels reductions.

3.2 Land Uses

3.2.1 Land Use

The Elk Creek Watershed contains approximately 85,424 acres and is located in southwest Oregon in the Oregon Western Cascades physiographic province. Elevations in the watershed range from 1,474 feet to 5,500 feet.

Roughly one-third of the drainage (26,863 acres) is managed by the Rogue River National Forest as part of LSR 222. The lower two-thirds of the watershed (58,561 acres) is a mixture of industrial forest lands (27,319 acres) and BLM-administered lands (23,866 acres) in a checkerboard ownership pattern. The BLM-administered lands are managed as part of LSR 224. Table 1.1-1 and Map 1-1b illustrate the land ownership or jurisdiction within the project area. Consistent with the Medford District Resource Management Plan (RMP), it is assumed industrial forest lands will be intensively managed with final harvest on commercial economic rotations averaging 60 years. Following control of the Timbered Rock Fire, salvage operations began on some private industrial forest lands.

Private agricultural lands and USACE lands are located along the main stem of Elk Creek. The main valley of Elk Creek has extensive alluvial deposits where most of the private agricultural lands are located. Most private homes along Elk Creek are located from Sugarpine Creek to the Rogue River confluence. Private agricultural and rural residential lands cover about 4,335 acres. The USACE acquired approximately 2,617 acres of land for the Elk Creek Dam project. These lands are located along the lower reaches of Elk Creek between Flat Creek and Elk Trail School. The USACE lands are being managed in a custodial manner pending resolution of the Elk Creek Dam controversy.

A small parcel of Umpqua National Forest-administered lands (186 acres) in the northwest portion of the watershed is managed as a part of LSR 222. The remaining 238 acres, located in the southern part of the watershed, is managed by the Oregon Division of State Lands.

3.2.2 Land Use Allocations and Restrictions

The project area includes only BLM-administered lands within the Elk Creek Watershed. A 400-foot "buffer" along the divides with Trail and Lost creeks has been included to provide an opportunity to analyze creation of fuel management zones. On October 30, 1998, the Medford District BLM and Rogue River NF completed a land exchange resulting in the transfer of approximately 2,055 acres of National Forest lands within T33S, R1W to BLM administration. While these lands are not designated as LSR, it is the policy of BLM to manage acquired lands consistent with adjacent lands until the next planning update.

The Record of Decision and RMP for the Medford District was approved in June 1995. The RMP incorporated "Land Use Allocations and Standards and Guidelines" from the *Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl* which is attached to and a part of the *Record of Decision For Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl,* also known as the Northwest Forest Plan (USDI and USDA 1994). This EIS is tiered to the Final EIS for the Northwest Forest Plan (NFP). Following is a summary of pertinent management direction contained within the NFP and RMP as it pertains to the project area (see Map 3-1).

3.2.2.1 Late-Successional Reserve

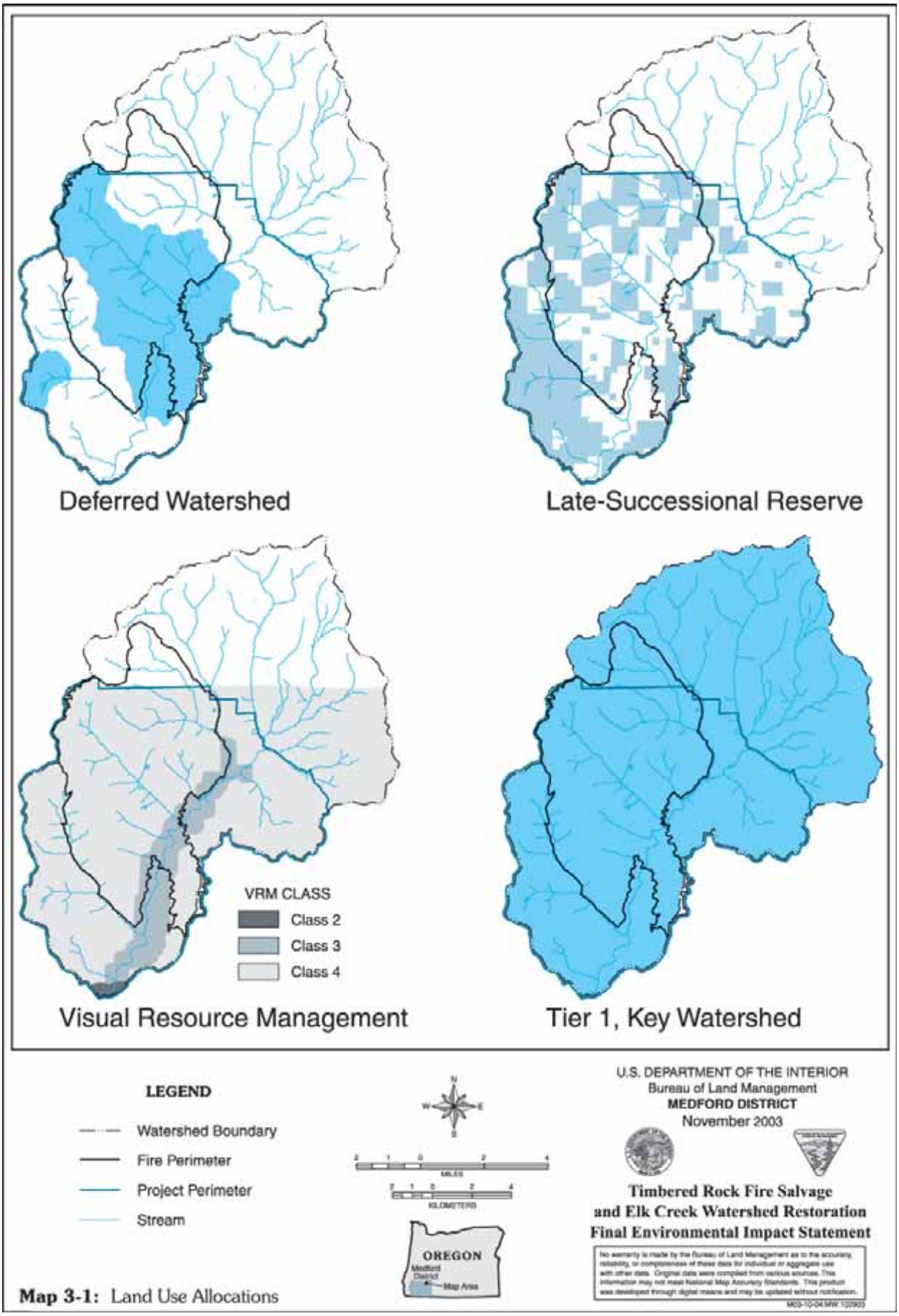
Under the NFP and Medford District RMP, BLM-administered lands within the Elk Creek Watershed were designated as LSR 224 (see Appendix A). The overall management objective for LSR management is

> "Late-Successional Reserves are to be managed to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth related species including the northern spotted owl" (USDA and USDI 1994).

The Elk Creek Watershed Analysis (July 1996) and South Cascades LSR Assessment (February 1998) were prepared following LSR direction in the NFP. While not decision documents subject to NEPA analysis, they provide background information and management recommendations used in the preparation of this draft EIS.

3.2.2.2 Riparian Reserves

Riparian Reserves, designated under the NFP and Medford District RMP, overlay other land use allocations and are dispersed throughout the project area. Riparian Reserve widths are 160 feet on each side of the stream for non-fish-



Map 3-1: Land Use Allocations

bearing streams and 320 feet on each side of the stream for fish-bearing streams. Appropriate widths have also been set for other water bodies, such as constructed or natural ponds or reservoirs, wetlands, and intermittent streams. Riparian Reserves are managed to provide benefits to riparian-associated species, enhance habitat conservation for organisms dependent on the transition zone between upslope and riparian areas, improve travel and dispersal for many terrestrial animals and plants, and provide for habitat connectivity within the watershed. They also serve as corridors to connect LSRs.

3.2.2.3 Key Watershed

Both BLM- and National Forest-administered lands within the Elk Creek Watershed were designated as Tier 1 Key Watershed under the NFP. Key Watersheds contribute directly to conservation of at-risk anadromous salmonids and/or resident fish species. They have a high potential for being restored as part of a watershed restoration program. The NFP directs road mileage for existing system and non-system roads should be reduced and there will be no net increase in roads within Key Watersheds (USDA and USDI 1994, B-19).

3.2.2.4 Aquatic Conservation Strategy (ACS)

The ACS was developed within the context of the NFP to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands. The strategy would protect salmon and steelhead habitat on Federal lands managed by the Forest Service and Bureau of Land Management within the range of the Pacific Ocean anadromous fish. To comply with ACS objectives, an agency must manage the riparian-dependent resources to maintain the existing conditions or implement actions to restore conditions. Standards and Guidelines focus on “meeting” and “not preventing attainment” of ACS objectives.

3.2.2.5 Deferred Watersheds

All or parts of Alco, Middle, Flat, Miller, Jones, and Yellow Rock creeks were designated as “deferred watersheds” in the RMP because of high cumulative effects. They were deferred from timber harvest and other management activities for 10 years (ending January 2003) at which time the deferral could be reevaluated. It is anticipated they will be reevaluated during the next RMP planning cycle. Management activities of a limited nature (riparian, fish or wildlife enhancement, salvage, etc.) could be implemented if they do not increase cumulative effects (see Section 3.4 - Hydrology).

3.2.2.6 Paired Watersheds

Hungry Creek and parts of Upper Morine Creek were identified as a “paired watershed” in the RMP. This area is a watershed monitoring area and was deferred from timber harvest and other management activities. These watersheds can be used to monitor the effects of management activities on water quality and quantity (see Section 3.4 - Hydrology).

3.2.2.7 Other RMP Management Direction

A few acres of “sensitive soils” were identified in the RMP. A potential hiking trail from Buck Rock to Berry Rock was identified and has not been developed. Most of the Elk Creek Watershed has been designated as VRM Class IV. Some public lands along Elk Creek were identified as located in the Rural Interface and as VRM Class III.

3.3 Soil

- Soil is one of the resources most affected by wildfire.
- In order to quantify the affects of the alternatives on the broad-term soil resources, this analysis separated effects into four categories: mass wasting, soil erosion, soil disturbance, and soil productivity.
- Soil disturbance is a broad category generally considering compaction, displacement, puddling (ruts), burned soils, and erosion.

3.3.1 Methodology

The Burned Area Severity Map ratings are based on the potential effect on soil resources.

Erosion potential ratings were supplied by Natural Resources Conservation Service, in conjunction with previous studies on the effects of timber salvage on soil resources.

An Erosion Potential map was produced for the Elk Creek Watershed Analysis (USDA and USDI 1996) from data found in the Soil Survey of Jackson County, Oregon (USDA 1993). This Survey mapped the County at two levels of intensity; a higher level for lands under agricultural or community development and a lower level for gently-sloping to steep soils, like those in the Elk Creek Watershed. Since mid-1990, the Natural Resources Conservation Service (NRCS) has been updating the erosion potential interpretation tables.

The electronic database (OR632 Jackson County Area) supersedes findings in the 1993 Survey (USDA 2002). This updated database was entered into the Medford BLM Geographical Information System (GIS) at the start of this project.

Recreating the Elk Creek Watershed Erosion Potential map using this updated information produced a new interpretation of the erosion potential (see Map 3-4). Erosion potential changed from predominately severe to predominately

moderate. No BLM-administered land within the DEIS Project Boundary is rated as having severe erosion potential.

Estimates of amounts of organic material consumed by the fire and present after salvage were based on a study completed on the Silver Fire for Siskiyou National Forest (USDA 1988, C-4-7).

The BLM Elk Creek Watershed Analysis (USDA and USDI 1996) and the Boise Corporation Elk Creek Watershed Analysis (Boise 1999) were the primary information sources for the assessment of erosion and mass wasting for the pre-fire conditions of the watershed. This information was supplemented with field surveys of the area in December 2002 and in the spring and summer of 2003, in order to assess the post-fire conditions and any relevant changes in the watershed. This field review included an assessment of stream-crossings, road conditions, and special problem areas, and a reconnaissance of proposed salvage areas.

Post-fire field surveys were conducted on most units proposed for tractor yarding and on some units proposed for cable yarding. Twenty-seven transects of up to twenty-five data points each were taken.

3.3.1.1 Assumptions

Basic mechanisms behind how landscapes respond to fire and logging would be similar regardless of location (McIver 2001, 160).

Short-term, as used in this soil report, is defined as one to five years. Long-term is defined as greater than five years.

Total organic matter remaining after the fire and after salvage is the key indicator for the issue of site productivity.

Estimates of severe soil disturbance, erosion, and sediment transport were used to determine compaction and erosion relative to yarding method (tractor, cable skidding, skyline, and helicopter). Percents are based on a 1975 study by Klock, which generally involved clearcutting with no pre-designated skid trails and no streamside buffers (Klock 1975).

Klock did not include an estimate for erosion and sediment transport caused by skyline yarding. The project hydrologist and soil scientist conferred and chose 5 percent as a working figure.

Pre-designated skid trails and buffers would be required in this project, as required by the BLM Medford RMP. Therefore, the maximum estimate of soil disturbance for tractor and bull-line yarding is 12 percent.

It was assumed that due to decay, dead trees less than 16" DBH would be left. If dead trees less than 16" DBH are found to be intact, they may be harvested.

3.3.2 Affected Environment

The Elk Creek Watershed lies in the Western Cascades geologic province, and is characterized by volcanic rocks: tuffs, basalts, andesites, and breccias. The predominant bedrock types are Western Cascade volcanics (Twc) (i.e. basalt, andesite, tuffs and sedimentary volcanic rock) and intrusive volcanic rocks (Tii and Tmi). The volcanic bedrock weathers and decomposes into small-grained material with a tendency to erode easily. A smaller occurrence of basalts and andesite flows (Qtba, geologic unit) can be found in the east and northeast area of the watershed. Both older and more recent stream deposits (i.e. silts, sands and gravels – Quaternary Alluvium, Qal) can be found along the existing streams and their terraces (Boise 1999, Map A-2).

The most prevalent soils in the watershed are McNull, Medco, Straight, Shippa and Freezener, and Geppert soils and associated complexes. The parent material is andesite, tuff, and breccia bedrock. The soils are predominately cobbly or gravelly clay loam, of moderate to slow permeability. The soil classification, per Unified Soil Classification System, is silty or clayey gravels (see Table 3.3-1).

3.3.2.1 Mass Wasting – Uplands

Pre-fire

Mass wasting, in the form of slope creep and landslides, was identified in the Boise WA as the major contributor of background (natural) sediment delivery into the streams. The background sediment delivery from mass wasting for the entire watershed was estimated at 3,300 tons per year (Boise 1999, 14). The sediment delivered from mass wasting in the harvest units were estimated at 1,700 tons per year (Boise 1999, B-20). Mass wasting, as visible and recognizable soil movement, occurs as a result of major and/or prolonged rainy events, more specifically the rise of groundwater within a soil mass, or as a result of seismic events. These natural, episodic events deliver ordinary coarse material (soil, sand, gravels, cobbles and boulders, and wood material) into the streams.

An extensive analysis of mass wasting for the entire Elk Creek Watershed was conducted by Boise Cascade Corporation (Boise 1999). Their methodology included the analysis of aerial photographs (from 1943 to 1996), field reconnaissance, and assessment of size and sediment delivery to streams. The mass wasting features were divided into three categories based on their form and behavior: shallow rapid slides (SR), large-persistent deep-seated slides (LPD), and debris torrents (DT).
Among their findings were:

- A total of 125 mass wasting features were identified in the Elk Creek Watershed – 68 road-related, 57 uplands – between 1943 and 1996.
- Summary of landslides by type: 60 (48 percent) shallow

Table 3.3-1 Summary of Soil Properties

Soil Number	Name	Parent Material	Texture	Soil Depth (inches)	Permeability
113G	McMullin-rock outcrop complex	Igneous/ metamorphic rock	Gravelly clay loam	17	Moderate
114G	McNull loam N slopes	Andesite, tuff, breccia	Loam	32	Slow
115G	McNull loam S slopes	Andesite, tuff, breccia	Loam	32	Slow
125F	Medco-McMullin complex	Andesite, tuff, breccia	Cobbly clay loam	25	Slow/moderate
126F	Medco-McNull complex	Andesite, tuff, breccia	Cobbly clay loam	31	Very slow
184G	Straight-Shippa extremely gravelly loams N slopes	Andesite, tuff, breccia	Very gravelly loam	25	Moderate
185G	Straight-Shippa extremely gravelly loams S slopes	Andesite, tuff, breccia	Very gravelly loam	25	Moderate
64E	Freezener gravelly loam S slopes	Andesite	Gravelly clay loam	60	Moderately slow
66G	Freezener-Geppert complex N slopes	Andesite	Gravelly clay loam	45	Moderate
67G	Freezener-Geppert complex N slopes	Andesite	Gravelly clay loam	45	Moderate

Source: Boise Watershed Analysis, 1999, Table B-1.1

rapid (SR); 55 (44 percent) debris torrent (DT); 10 (8 percent) large persistent deep-seated (LPD).

- High precipitation events (1964 and 1996) delivered the highest volume of sediment: 52 percent of the total volume. Most slides, 99 percent, are in the Twc and Tii geologic units.
- Virtually all the land within the fire perimeter in the Twc and Tii geologic units.
- Approximately 60 percent of all landslides delivered to streams.
- Majority of landslides (79 percent) occur in concave slope morphology.
- Greatest concentration of slides (approximately 50 percent) was in the Burnt Peak area after the fire in 1987.
- Landslides as a result of fire (Burnt Peak 1987) delivered 10 percent of the total volume.

Based on the analysis, the entire basin was grouped into seven Mass Wasting Map Units (MW Unit) that provide general information related to management actions in those geomorphic areas (Boise 1999, A-23). The summary indicates certain specific areas within the watershed require further analysis when management activities are planned there. The “at-risk” areas in the watershed are:

- MW Unit 3 – steep slopes (>75 percent) in Tii, concave slope morphology.
- MW Unit 5 – steep slopes (>75 percent) in Twc, concave and planar slope morphology.
- MW Unit 6 – steep slopes (> 55 percent) in Burnt Peak area, concave and planar slope morphology.

The fire in the Burnt Peak area in 1987 had a profound effect on the incidence of mass wasting in that area. This area contains less than 5 percent of the watershed area and has a similar geological composition as the rest of the watershed. However, 40 percent of the total numbers of slides and almost 30 percent of the total volume of sediment delivered to the streams. Most of the slides were associated with roads (fill and cut slope failures) and debris torrents in the steep, confined channels.

Among the contributing factors of the increased mass wasting were:

- Prevalence of steep slopes (>65 percent) across the majority of the unit.
- Extensive road building and harvesting in the area prior to the 1987 fire.
- High intensity fire across the majority of the unit.
- Reduced root strength on steep slopes within 10 years after the fire.

Among the relevant conclusions contained in the two watershed analyses are:

- Landslide density (number per acre) is slightly higher in non-forested or clearcut areas.
- Slides occurred most frequently on steep slopes (>65 percent) in concave slope morphology.
- Landslide density in the Elk Creek Watershed is low

Table 3.3-2. Slopes in the Elk Creek Watershed

Percent Slope	BLM		Private		Others		Total Acres
	Acres	Percent	Acres	Percent	Acres	Percent	
0-64	20,900	24%	27,900	33%	26,850	31%	76,650
65-74	1,700	2%	2,350	3%	1,700	2%	5,750
75-84	850	1%	1,150	2%	800	1%	2,800
85+	400	<1%	250	<1%	550	<1%	1,200
Totals	23,850	28%	31,650	38%	29,900	34%	85,400

NOTE:
1. Acres are rounded to the nearest 50 acres.
2. The topographic maps (1:24,000, 7.5 minute) have limited accuracy in representing steep slopes, according to an ODF study (1999).
3. "Others" are other public land administrators, i.e. US Forest Service, USACE, and State of Oregon.

enough to be of little concern, except for the high rate of landslides in the burn area (see Map 3-2).

- Natural landslides are a source of gravels beneficial in the creation of spawning beds.

A GIS analysis of the Elk Creek Watershed indicates the area contains approximately 9,750 acres of land with slopes greater than 65 percent, or 11 percent of the entire fire area (see Table 3.3-2).

These steep land areas are distributed among the landowners and land management agencies as follows:

- BLM - 2,950 acres or 3 percent of the watershed.
- Private lands - 3,750 acres or 4 percent of the watershed.
- Other public lands (USFS, USACE, State of Oregon) - 3,050 acres or 4 percent of the watershed.

Post-fire

The Timbered Rock Fire affected approximately 27,100 acres, or 32 percent, of the entire Elk Creek Watershed area, including 11,774 acres of BLM-administered land and 11,750 acres of private lands. The remainder of the burn area, 3,576 acres, is administered by other public agencies.

The high and moderate burn severity areas were distributed as follows:

- BLM - 3,702 acres or 14 percent of the burned area.
- Private lands – 6,219 acres or 23 percent of the burned area.
- Other public lands (USFS, USACE, State of Oregon) - 739 acres or 3 percent of the burned area.

Scientific literature (McIver and Starr 2000) implies large-scale fire, prescribed or natural, in a mountainous terrain has similar effects on slope stability as large-scale timber harvesting. Increased instability is caused by reduced evapotranspiration and decreased root strength. This condition is temporary, lasting approximately 10 years, with the critical time period occurring between 3 and 8 years after the large-scale deforestation (clearcutting or fire). The effects of fire on the incidence and consequences (sedimentation) of land slides are considerably greater, since many burned riparian areas no longer function as buffer zones for the upland erosion and landslides.

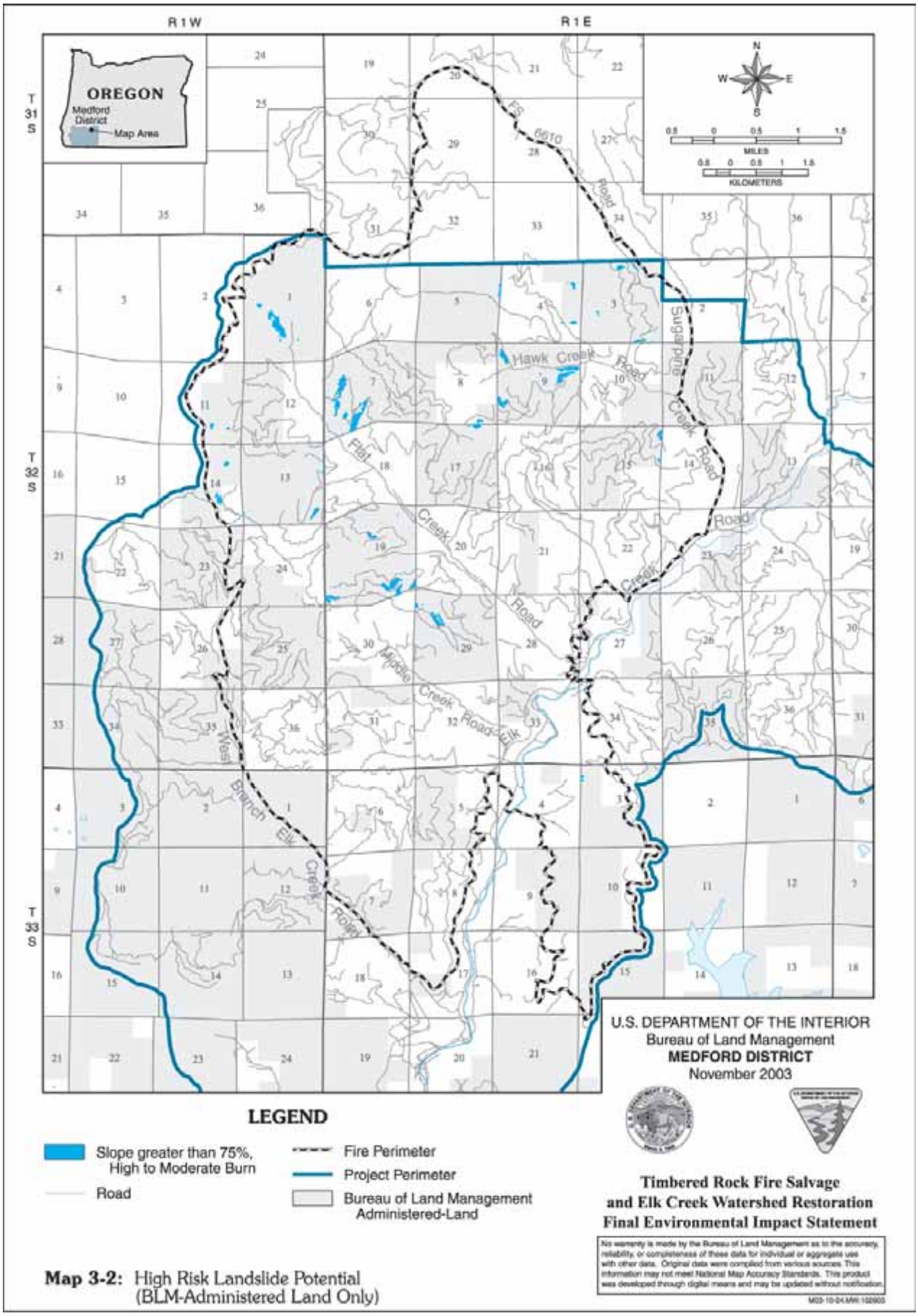
The fire in the Burnt Peak area in 1987 resulted in the greatest concentration of landslides (slides per acre) in the Elk Creek Watershed. Of the total sediment delivered to the streams in the period between 1943 and 1997, approximately 10 percent was delivered as a result of this fire. Most of the landslides were associated with roads (fill failures) and steep channels (debris torrents). The primary cause was the high water runoff from the burned areas resulting from hydrophobic soils, reduced hydraulic depth of the soils, and reduced evapotranspiration.

The review of post-fire aerial photographs and limited field reconnaissance of the uplands, roads, and stream channels in December 2002 and January 2003 resulted in the following observations and conclusions (Note: A 2- to 5-year storm event occurred in December 2002):

- Numerous occurrences of small debris torrents.
- Increased scour and bank sloughing of stream banks.
- No slides were identified or observed during the field review.
- Numerous existing and impending road fill failures.
- Large-scale salvage operation of burned areas on private lands.

3.3.2.2 Debris Torrents

Debris torrents are a natural part of the hill-slope processes in the mountainous terrain of the Pacific Northwest. They occur primarily in steep, confined channels during major precipitation events. Torrents are highly destructive, but also highly beneficial to the proper function of stream systems and fisheries resources by delivering heterogeneous material (boulders, gravels, and LWD) to the streams and creating complex stream systems (Swanston 1980; Eisbacher and



Map 3-2: High Risk Landslide Potential (BLM-Administered Land Only)

Calgue 1984). Researchers concluded timber harvesting and road building greatly increase the occurrence of the torrents in a mountainous watershed (Swanson 1978; Sidle, et al. 1985). Large-scale fires have essentially the same effects on the incidence of debris torrents as large-scale harvesting. This is primarily due to substantially increased peak lows (loss of tree canopy) and increased incidence of mass wasting within the channels (reduced root strength and evapotranspiration).

Pre-fire

Aerial photo interpretation and field verification identified 55 debris torrents in the Elk Creek Watershed between 1943 and 1997. This number represents 44 percent of all mass wasting events. The majority of the events occurred in the Twc geologic unit (79 percent) and most were road-related (66 percent). A strong correlation was made between the Burnt Peak Fire in 1987 and debris torrents; 29 percent of debris torrents were attributed to post-fire effects, such as increased peak flows. The majority of the remaining torrents occurred in steep terrain within the Twc geologic unit in the Sugarpine Creek Watershed (Boise 1999, Table A-3).

Post-fire

Research indicates peak flows increase between 100 percent and 200 percent in a burned watershed (Halvey 1980). This is due to a post-fire increase in temporary water repellency and a decrease in infiltration rates in the moderately and severely burned areas. The areas with low burn severity are generally assumed to maintain their pre-fire hydraulic and hydrologic characteristics.

Field reconnaissance of the fire area in December 2002 and January 2003 revealed numerous small debris torrents, and visible erosion and scour of stream bed and stream banks.

The most vulnerable areas to the debris torrent hazard are channels in steep topography, where burn severity was moderate and high. The channels considered to be “at high risk” are located in Flat Creek (Sections 17 and 29), Middle Creek (Section 29), and Alco Creek (Section 5).

3.3.2.3 Mass Wasting – Roads

Pre-fire

Between 500 and 600 miles of active roads are located in the Elk Creek Watershed (Boise 1999). Surface erosion and mass wasting from the roads have been identified as major sources of human-caused sediment delivered into streams. Compared to current standards, most roads were built between 1970 and 1990 with low engineering standards: undersized drainage structures, inadequate fill compaction, sidecasting of excavated material, and insufficient number of road drainages. As a result of the inadequate road engineering practices, erosion processes have been greatly accelerated. Roads occupy only a small part of the watershed, 4 to 6 percent, yet the road-related landslides account for 46 percent of all identified landslide events in the watershed (Boise 1999). The background (natural) sedimentation was estimated at 3,250 tons per year. The erosion from mass wasting along roads was estimated at 6,970 tons per year, an increase of 210 percent. Erosion from road surfaces was assessed at 3,710 tons per year, an increase of 110 percent (Boise 1999, Table B-11).

Landslide densities associated with roads were greatest in the Tii and Twc geologic units, in concave slope morphology (92 percent), on steep slopes (>70 percent), and were almost equally distributed between cut and fill slope failures (Boise 1999).

Fill failures at road stream-crossings in steep mountainous terrain often result in debris torrents. The failures are the result of poor fill design and construction, obstruction of drainage structures, and increased flows from uplands, due to large-scale clearcutting or fires, and added flows from adjacent road surfaces (Schroeder and Brown 1984). Assessment of mass wasting in the Elk Creek Watershed by Boise indicated 33 out of 56 identified debris torrents were associated with roads (Boise 1999, Table A-3). This points to the critical nature of these structures and their potential effects on the condition of the riparian areas, delivery of large quantities of undesirable anthropogenic sediment into the streams, and the potential repair costs, in case of road failures. Table 3.3-3 shows the distribution of road stream-crossings in the Elk Creek Watershed by stream type, BLM maintenance responsibility, and estimated sediment volume “at-risk”.

Table 3.3-3. Road Stream-Crossings in the Elk Creek Watershed

Stream Type	Number of Crossings	Crossings under BLM Maintenance Responsibility	Potential Sediment Volume “at-risk”
Short-term Intermittent	1,087	270	110,000 yd^3
Ephemeral	758	200	120,000 yd^3
Long-term Intermittent	423	119	130,000 yd^3
Perennial	202	50	100,000 yd^3

Post-fire

Numerous impending and existing road fill failures were noted during field review in December 2002 and January 2003. Most of the instability was the result of road widening and fill side casting during the fire or road maintenance activities. It appears the road maintenance practice consisted of removing sloughed and eroded soil from the ditch line and placing (side casting) it onto the adjacent slope, thereby increasing the instability of the fill slope.

Some road stream-crossings in the fire area appear to have become destabilized due to the increased stream flows, or due to blockage of the drainage structures, and the subsequent fill overtopping. Most of the instability was in the form of excessive erosion of the downstream road fill slope.

3.3.2.4 Soil Erosion

Pre-fire

The 26 soils identified in the fire perimeter are all volcanic in nature. Soil descriptions are detailed in the Elk Creek Watershed Analysis (USDA and USDI 1996) and the Soil Survey of Jackson County (USDA 1993). See the Soils Concern Table in Appendix H for acres of each soil, burn severity acres within the fire perimeter, and other concerns relative to woodland management.

None of these soils are unique, but a combination of 1 to 3 main soils containing as much as 20 percent other soils. The Revised Universal Soil Loss Equation (RUSLE) related attributes table in Appendix H details the percent of major soils contained within the 26 soils identified in the project area along with data relevant to the RUSLE.

The Jackson County Soil Survey (1993) produced a General Soils Map which placed the 26 soils in the EIS project area into 2 general groupings: general soils 9 and 13 (see Map 3-3).

The majority of soils within the Timbered Rock Fire perimeter are classified as general soil 9 (Straight – Freezener – Shippa).

Straight soils are moderately deep. The surface layer is extremely gravelly loam. The subsoil is very gravelly loam and very cobbly clay loam. Straight soils formed in colluvium derived from igneous rock.

Freezener soils are very deep. The surface layer is gravelly loam. The subsoil is clay loam and loam. Freezener soils form in colluvium and residuum derived from igneous rock.

Shippa soils are shallow. The surface layer is extremely gravelly loam. The subsoils are extremely cobbly loam. Shippa soils form in colluvium derived from igneous rock.

The southern and eastern edges of the fire and the rest of the EIS project area are classified as general soil 13 (McNull – McMullin – Medco).

McNull soils are moderately deep and well-drained. The surface layer is loam. The subsoil is clay loam and cobbly loam. McNull soils form in colluvium from weathered andesite and basalt under the influence of soft, easily weathered tuff and breccia.

McMullin soils are shallow and well-drained. The surface layer is gravelly loam. The subsoil is gravelly clay loam. These soils form in colluvium derived from igneous rock. Medco soils are moderately deep and moderately well-drained. The surface layer is cobbly clay loam. The subsoil is clay. Medco soils form in colluvium derived from igneous rock and often form in landslide deposits on concave slopes where there is concentration of water that influence easily weathered tuff and breccia.

The background sediment yield, summarized in the 1999 Boise Elk Creek Watershed Analysis, was calculated for areas within the fire perimeter (see Table 3.3-4). Methodology involved combining creep rate calculations with a component of stream bank erosion. Confidence in the background sediment erosion estimates is moderate (Boise 1999, B-6-7).

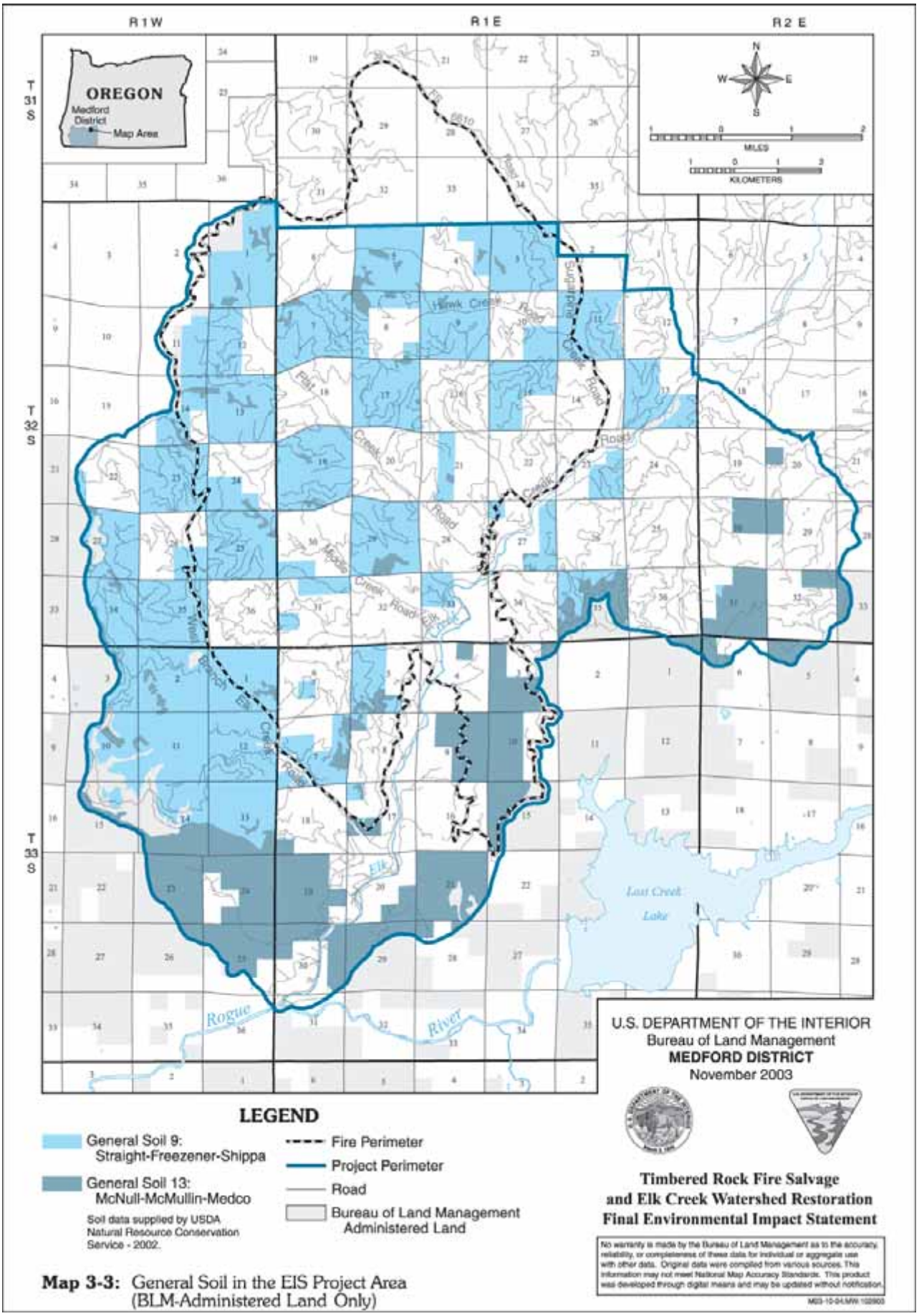
The majority of sediment reaching the channels consists of particles less than 2 mm in size, much of it in the clay-sized fraction that will stay in suspension (Boise 1999, E-3). While extensive logging, ranching, and other land uses have affected stream temperatures, they have not had much affect on turbidity in the streams (USDA and USDI 1996, II-19).

An Erosion Potential map (Map 3-4) was produced for this project from data supplied by the Natural Resources Conservation Service (USDA 2002). Erosion potential was predominately moderate. No BLM-administered land within the project area rated as having severe erosion potential.

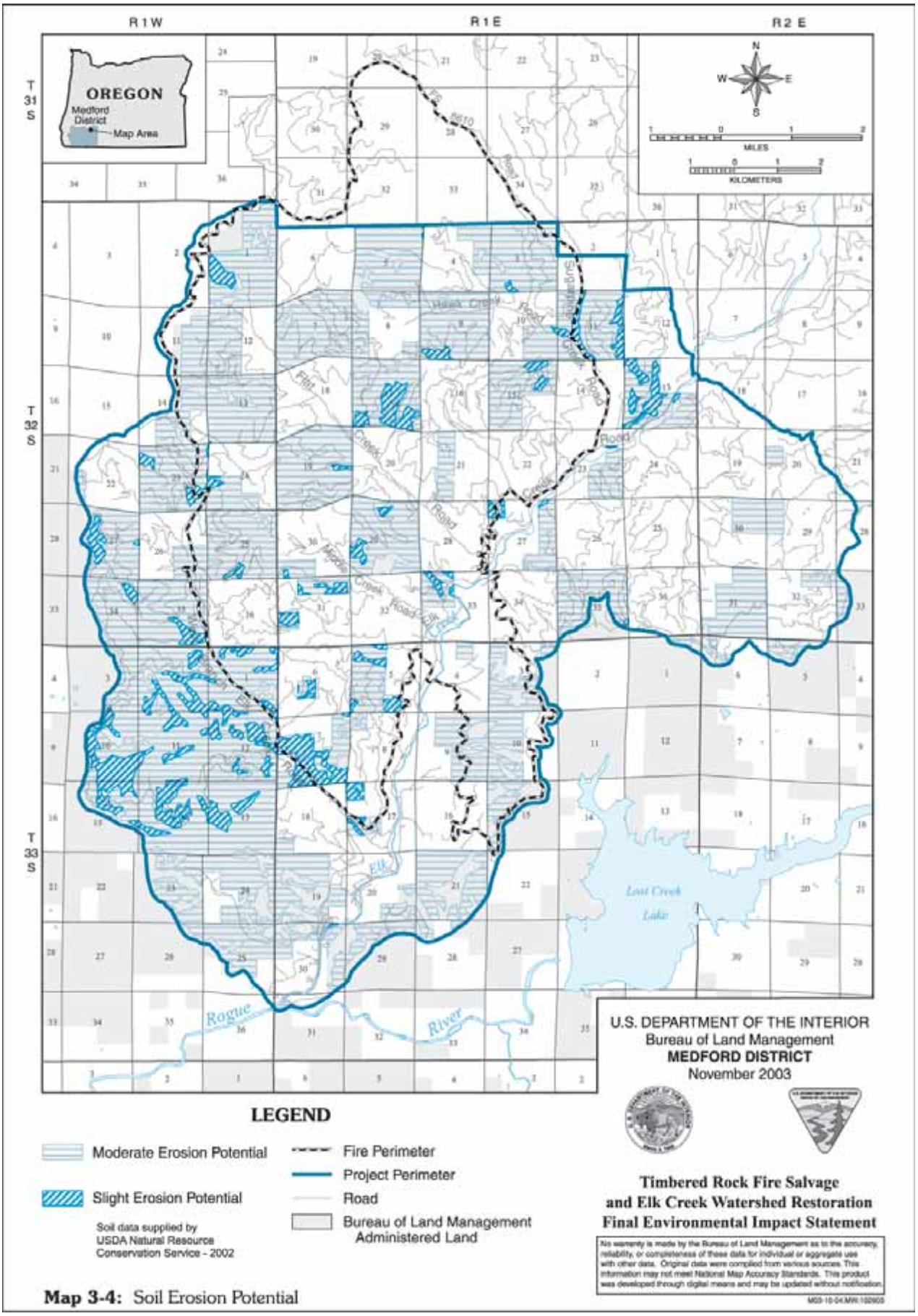
Fragile Soils, as defined by the BLM Medford District RMP, are limited within the fire perimeter (USDI 1995). These soils are classified as fragile soils sensitive to surface-disturbing activities by virtue of being prone to slump and earth flow types of mass movement. Isolated patches of Fragile Soils occur within the fire perimeter to the east of

Table 3.3-4. Background Erosion Rates

Sub-basin	Area (acres)	Total Soil Creep (tons/year)	Mass Wasting (tons/year)	Total Background Sediment Input (tons/year)
Flat Creek	7,592	170	100	270
Sugarpine	17,444	470	70	540
West Branch	10,705	330	0	330
Total Fire Perimeter	35,741	970	170	1,140



Map 3-3: General Soil in the EIS Project Area (BLM-Administered Land Only)



Map 3-4: Soil Erosion Potential

Corps of Engineer lands in Sections 3, 9, 10, and 15. Outside the fire perimeter but within the project area, Fragile Soils are found to be extensive in the headwaters of Morine Creek, isolated patches in the Berry Creek drainage, and also to the southeast of the fire in Sections 20, 21, and 29.

Erosion relates to the ease of detachment and movement of soil and rock particles. This material has not entered the aquatic environment, but rather the colluvial environment where it could remain for a few years to millennia. Almost all soils on hillslopes form in colluvium.

In the past, harvest activities resulted in disturbance and erosion in stream channels. Harvest of riparian areas and yarding in stream channels caused erosion in many tributaries during the 1960s and 1970s. The bedrock-based stream channels have not yet recovered from these disturbances, but the riparian vegetation has regrown and erosion is no longer occurring from past harvests. Current harvest practices result in little eroded sediment reaching streams. Most sediment was deposited in buffer strips or flat areas before it reached streams (Boise 1999, B-9).

Soil erosion occurs infrequently in undisturbed forests because the soil surface is protected by both vegetation and organic matter. The abundant layer of organic debris (duff) on the soil surface and the decomposed organic matter incorporated into the soil profile (humus) protect soil from erosion by allowing the rate at which water moves into and through the soil profile to equal or exceed the rate of precipitation or snow melt. Organic matter reduces the likelihood of overland flow and subsequent soil erosion.

Several factors influence the amount of erosion following fire and management activities. These factors include climate, soil characteristics (texture, organic matter, structure, and permeability), topography, and ground cover. In general, finer-grained soils erode more easily and steeper slopes have a higher erosion potential. “The potential for erosion is greatest in granitic and sedimentary soils.” (Brown 1989, 108). There are no granitic or sedimentary soils within the EIS project area.

Ground cover refers to any surface cover protecting the soil from erosion. These covers would principally be vegetation, but can also include rocks, needle fall from burnt trees, woody debris, and slashed brush from logging activities, and surface treatments such as mulches, netting, and erosion blankets. Road use in the Elk Creek Watershed is the largest contributor of sediment resulting from management activities, with road surface erosion adding the equivalent of the background sediment yields (see Table 3.3-5) (Boise 1999, B-20).

Road surfaces and ditches account for 80 percent of road-related sediment and cutslopes produce 20 percent. This problem is exacerbated by cleaning ditch lines, which removes the toe of cutslopes and perpetuates cutslope erosion (Boise 1999, B-18).

Table 3.3-5. Road Surface Erosion

Subbasin	Background Erosion (tons/ year)	Road Surface Erosion (tons/year)
Flat Creek	270	280
Sugarpine	540	450
West Branch	330	640

Approximately seven miles of new road were constructed by private industry within the fire perimeter during 2002 and 2003. This new construction took approximately 28 acres out of timber production.

Erosion would also occur in previously harvested units where skid trails can concentrate and channel running water. Skid trails within the fire perimeter are common on previously entered BLM-administered lands with slopes less than 35 percent. The most recent of these skid trails was built during the last entry for timber harvest in 1986. Water bars on these skid trails would mitigate concentration and channeling of running water.

Post-fire

Fire has been an important influence in the development of forested ecosystems and soils in the Elk Creek Watershed. The effects of fire on soils are variable depending on the intensity of the fire and the type of fuels consumed. If forest litter and the decomposed organic material on and in the soil are not totally consumed, then fire effects on soil are usually minimal.

In areas of moderate to high burn severity, all the duff and litter on forested sites, including logs on the forest floor, were consumed. This can heat the soil enough to make fine-textured soils, such as clays and silts, increase in coarseness. At the same time, loss of all the surface cover has the potential to decrease the movement of water into soil, increase the potential for overland flow of water, and increase the risk of erosion. Field surveys revealed that beneath the top one or two inches of the surface, soil physical properties are relatively unaffected and soil structures are intact and functioning.

In areas of very low and low burn severity, very little to no damage occurred to the soil resources (see Table 3.3-6).

Fire recycles nutrients otherwise stored in organic matter on the forest floor and unavailable for plant use. After a fire, many nutrients are made available for use by vegetation. Usually following wildfire, there is a short-term increase in soil fertility lasting several years. However, if the organic matter of the mineral soil is lost or reduced, which can occur

Table 3.3-6. Burn Severity and Effects on Soil and Hydrologic Function on BLM Land

Burn Severity	Amount Burned		Litter and Duff Condition	Tree Mortality	Soil Structure	Adverse Impacts	Water Repellent	Runoff / Erosion
	Acres	Percent						
Unburned-Very Low	3,822	32%	Minimal consumption	Slight	Unaltered	None	None, unless natural	Same as pre-fire
Low	4,250	36%	Ample/intact	Slight	Unaltered	Slight to none	None, unless natural.	Same as pre-fire
Moderate	2,715	23%	Generally consumed. Replaced by needle fall, surface rock fragments and new litter, if present	Moderate to severe. Needles and leaves still present	Unaltered	Moderate	Spotty in top 1 mm	Increased rates for first winter
High	987	9%	Near complete consumption. Replaced by surface rock fragments and new litter, if present	100% Complete consumption of needles and leaves	Reduced, Fine roots are consumed in first few cm.	Severe	Spotty in top 1 to 2 cm. in 20-50% of area	Increased rates for 3 to 5 years

in hot, long-duration fires, then the ability of the soil to hold nutrients leached from the ash is reduced. As a result, nutrients can be lost from the nutrient cycling system. The effects of the Timbered Rock Fire and potential alternatives could have varying short- and long-term consequences. The magnitude and duration of these effects depends on storm intensity, burn severity, soil characteristics, the extent of soil disturbance or impact following implementation of the selected alternative, and by following best management practices and project design features.

Accelerated surface erosion would occur, particularly on steep slopes, where loss of vegetation and duff has exposed soils. The erosion rates would substantially increase over pre-fire rates as the soil is exposed to raindrop detachment and increased overland flows. Surface gravels would increase as soil particles are displaced. The soils on steep slopes would continue to erode and ravel at a high rate until new vegetation is established. Additionally, burning of logs or other organic obstructions on hillslopes can release previously stored sediment to surface erosion (Swanson 1981, 403).

Riparian Reserves burned at a high or moderate burn severity lost all or most of the duff and litter present. This facilitated the movement of sediment into the aquatic environment during the first winter following the fire. Erosion rates would reduce as grasses and forbs recover; leaves, branches, and large woody debris accumulate; and hydrophobicity decreases.

Intense storms or rapid snow melt can exceed the capacity of the soil to accept, store, and move water through the soil profile. When this occurs, water runs over the surface of the ground. Erosion is possible if the soil lacks a protective ground cover. Post-fire overland flow and attendant erosion have not been documented in the Cascade Mountains of the Pacific Northwest. Precipitation in the Cascades occurs predominately as slow, steady winter rains. Thunderstorms occur about 5 times per year (Wondzella In Press, 3).

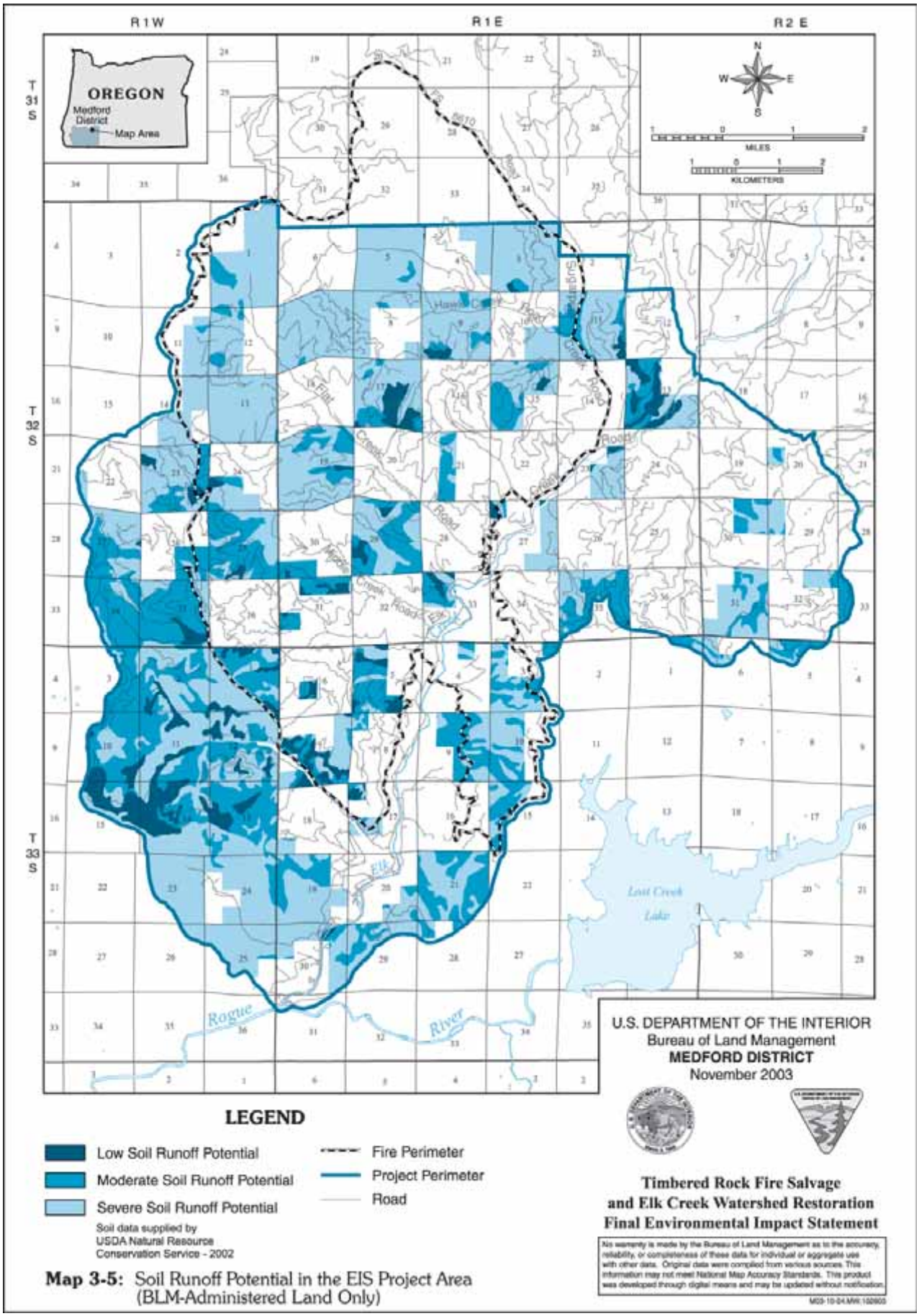
Sediment yields from erosion in the fire perimeter would considerably increase over the pre-fire yield. Accelerated rates of erosion may occur on extensively burned slopes adjacent to streams, inner gorges, talus slopes, and the steeper uplands, resulting in increased sedimentation. Field measurements after the first winter found 1.5 to 2.0 inches of surface erosion has occurred within areas of high burn severity. This is based on the presence of soil pedestals found in areas of fine-grained soils.

Post-fire research indicates 67 percent of eroded sediment is still stored in a watershed after 4 years, with an estimated residence time greater than 300 years (Moody 2001, 1049).

Riparian vegetation plays a critical role in filtering sediment from streams. “If streamside vegetation is removed… streambank erosion may occur.” (Brown 1989, 108).

Loss of organic matter and reduction of soil permeability as a result of management activities or wildfires can increase soil erosion. Organic matter improves soil structure and increases permeability and water holding capacity of the soil. Organic matter on the soil surface reduces impacts to the soil of raindrops and provides a rough surface to slow runoff and trap sediment.

A Runoff Potential Map (Map 3-5) was produced based on the Hydrologic Condition as defined for these soils by the NRCS. Severe to moderate runoff potential predominates the



Map 3-5: Soil Runoff Potential in the EIS Project Area (BLM-Administered Land Only)

project area. These ratings reflect shallow depth to bedrock in Straight-Shippa soils and the high clay content found in the subsoil of most other soils in the project area.

An underestimated impact on soils is caused by the branches of standing dead trees, which allow rainfall to coalesce into large, highly erosive raindrops that accelerate erosion around the bases of dead trees (Poff 1989, 138; Poff 2002, B-12; Duncan 2002, 3).

Topography includes slope length and slope steepness. These two factors determine in large part the velocity of runoff. Micro-topography can have a mitigating effect on erosion. On breaks-in-slopes and cat roads, eroding material would collect and stabilize, once vegetated. Stump holes and burned out roots would act as below-ground reservoirs for eroding ash and soil.

Wind-throw Hazard

Blowdown has potential to cause erosion. Blowdown can disturb large areas of soil, but it typically does not provide a direct linear path for sediment to reach streams. It can add debris and surface irregularities that trap soil particles. The erosion potential from blowdown is greatest when trees on the streambank fall over. Approximately 6,680 acres of BLM-administered land within the fire perimeter have a severe wind-throw hazard (predominately Straight - Shippa soils 184G, 185G), and approximately 60 acres have a moderate wind-throw hazard (predominately McNull and Medco soils 119F, 124F)(see Appendix H, Soil Concerns). These soils are prone to wind-throw due to shallow depths to bedrock in the Shippa soils. Though Medco soils are moderately deep, a dense clay layer at 6 to 18 inches limits effective rooting depth. Outside the fire perimeter but within the project area, 3,390 acres have a severe wind-throw hazard and 1,046 acres have a moderate wind-throw hazard. Loss of roots burned by the fire could exacerbate the wind-throw hazard.

Hydrophobic Soils

Fire has the potential to make soils hydrophobic, or resistant to the natural movement of water into and through the soil profile. This may impact summer water availability to sprouting and recently planted vegetation. This can occur in two ways; 1) fine-grained ash particles may prevent water infiltration by clogging pore spaces in the soil (Swanson 1981, 406; Beschta 1990, 221) and, 2) depending on the intensity of the fire, a physically or chemically impermeable crust may form near the upper surface of the soil.

The BAER specialist who prepared burn severity maps for the Quartz, Biscuit, and Squires Peak fires found more indications of hydrophobicity on the Timbered Rock Fire than on any fires during the last two years (Parsons 2003, pers. comm.)

When a fire is burning, hot gasses can be seen rising upwards. At the same time, vaporized organic substances are also driven into the ground. The hotter the fire, the deeper these gasses are driven until they reach cooler surfaces where they condense, sometimes forming an impermeable barrier (Debano 1998). It is important to note that even in unburned areas, soils may exhibit some water-repellent characteristics due to the nature of the leaf and needle litter or abundance of fungal mycelia.

Hydrophobic (water repelling) soils were found in areas of high burn severity on the Timbered Rock Fire. In some instances, the soil's water infiltration rate has been reduced by this water-repellent layer. Decreased infiltration results in increased surface runoff, redistributed subsurface water, and decreased summer water availability and stream flow rates. Water-repellent soils produce more erosion (Marston 1990, 3). This phenomenon can last for at least four years following fire (Campbell 1977, 14) but in general, water-repellent conditions following fire may be largely ameliorated during the first few fall rains and are not considered a major hydrologic concern in the Pacific Northwest, except in granitic soils (Beschta 1990, 221). Beschta also says the use of ground-based yarding systems may assist in disrupting the surface hydrophobic condition (Ice and Beschta 1999).

3.3.2.5 Soil Disturbance (Compaction and Displacement)

Pre-fire

Compaction and displacement can be caused by management activities requiring the use of heavy equipment. Soil displacement also occurs in unmanaged forests when trees fall over with their roots attached. Neither compaction nor displacement has a major effect on soil productivity when they occur in limited extent under natural conditions.

Weather influences the amount of soil compaction or soil displacement because wet soils compact more easily than dry soils. Pore spaces in soil are disrupted by soil compaction and soil displacement. Detrimental compaction is an increase in soil bulk density of 15 percent or more over the undisturbed level, a macro pore reduction of 50 percent or more, and/or a reduction below 15 percent macro porosity (USDA 1998, 3). Different soils have different bulk densities. Under natural conditions, some soils may have a bulk density higher than other compacted soils (see Appendix H - Table J1b for Physical Properties of Soils). If soils are detrimentally compacted, water concentrates on the soil surface rather than infiltrating into the soil.

Compaction also occurred in previously harvested units with skid trails. Skid trails, within the fire perimeter, are common on previously entered BLM-administered lands with slopes less than 35 percent. The most recent of these skid trails was built during the last entry for timber harvest in the early 1990s. The size of the trees growing on a majority of these

skid trails indicates compaction may not be a serious long-term impact from previous entries.

Post-fire

Within the fire perimeter, 22.6 miles of tractor line and 9.8 miles of handline were constructed, of which 7.7 miles and 3.6 miles, respectively, are on BLM-administered lands. Generally, one pass with a tractor constructs a fireline. Post-fire water bar construction would add a second pass (where tractors are used for water bar construction). Six trips with a tractor yarding logs increases bulk densities in the subsoil by 9.2 and 6.7 percent, respectively (Froehlich 1978, 5; Amaranthus 1997, 5). In fireline construction, tractors do not pull loads of logs, and the number of passes is generally less than three, consequently, there should have been little detrimental compaction resulting from fireline construction. Soil disturbance, which is mitigated by the distance from the aquatic environment (most firelines are on ridgetops) and the filtering of sediment by riparian vegetation, would occur.

Approximately 11,140 acres of private industrial forest lands burned in the Timbered Rock Fire. Of this, 2,060 acres were disturbed by tractor yarding. Skyline yarding impacted 3,255 acres and helicopter yarding impacted an additional 410 acres. This salvage amounts to approximately 21.1 percent of the burn area and 6.7 percent of the watershed.

A recent report suggests no management activity should be undertaken on burned soil which does not protect soil integrity. Salvage logging should be prohibited in sensitive areas and tractors and skidders should be generally prohibited (Beschta 1995, 9). In response, a separate report states that though sensitive areas need to be recognized, sensitive areas may be the sites most in need of management. The most severely burned sites may be the very ones that would benefit the most from post-fire logging by the disturbance of water-repellent layers and the lopping and scattering of litter (Ice and Beschta 1999).

Harvest methods, in order of increasing soil disturbance and erosion, are helicopter, skyline, tractor skidding, and cable skidding (Klock 1975, 81). Skyline and helicopter yarding would result in less soil disturbance than tractor yarding. It is estimated skyline yarding subjects up to 2.8 percent of the unit to severe disturbance. Helicopter yarding would expose about 0.7 percent of the unit to severe disturbance, whereas tractor yarding and cable skidding results in a maximum of 12 percent (Klock 1975, 80; as modified by the BLM practice of requiring designated skid roads).

The majority of soils in the project area have high rock content (35-65 percent gravel and cobble). Bridging of rock particles tends to decrease the effects of heavy equipment.

Burned Soils

The entire burned area was examined and assessed for burn severity following the fire. Burn severity describes the effects of the fire on soil and hydrologic function. Burn severity is classified as high, moderate, low, and very low (see Appendix M for complete descriptions of burn severity). In some cases, there may be complete consumption of vegetation by fire, with little to no effect on soil and watershed function. Other indicators of burn severity are depth, color, nature of ash, size of unburned fuels remaining, soil structure, and infiltration characteristics. In general, the denser the pre-fire vegetation and the longer the residence time, the more severe the effects of the fire on soil and hydrologic function (see Table 3.3-6).

Detrimentally-burned soils are defined as soil in which the mineral soil surface has substantially changed in color and oxidized to a reddish color. The next one-half inch was blackened from organic matter charring by heat conducted through the top layer. The detrimentally-burned soil standard applies to areas greater than 100 square feet, which are at least 5 feet in width (USDA 1998, 3). Detrimentally-burned soils have not been found on the Timbered Rock Fire.

The NRCS rated the 26 soils found within the fire perimeter, and their components, for the potential for damage to these soil by fire (see Appendix H, Table FOR-5). The majority of soils rate as having low potential for damage by fire. Soils 166A, 183E, and 184G rate as having a moderate potential for damage by fire. Soil 185G is also moderate but has a component rated as high (Shippa on 35-60 percent south slopes, 25 percent of 185G), and Soil 67G is rated as low but has a component rated as moderate (Geppert on 35-60 percent south slopes, 27 percent of 67G).

3.3.2.7 Soil Productivity

Pre-fire

Soil productivity is the ability of the soil to supply the nutrients needed to sustain plant growth. Nutrients available to plants are contained in the soil profile. They are released as organic matter decomposes or soil organisms die. Either soil organisms or fire must decompose organic matter before the nutrients it contains are available to plants. A shortage of any one nutrient can reduce the growth potential of vegetation. Nutrient shortages can result from changes in soil chemical or physical processes caused by fire, timber management, or road construction. Soil compaction can make nutrients inaccessible to plant roots. Loss of organic matter can reduce the amount of nutrients available to plants.

Almost a century of fire exclusion has occurred in this area. Consequently, “natural” conditions no longer exist. Fuel loading is greater and duff/litter layers are often greater than would naturally occur. Given the natural fire frequency in this area, many low severity fire events have been suppressed

over the past century. Large woody debris, as it decomposes, provides important habitat for fungi that form symbiotic relationships with tree roots, helping the tree acquire both nutrients and water. Soil organisms and their interactions profoundly affect forest-site productivity through capture and uptake of nutrients, nitrogen fixation, protection against pathogens, maintenance of soil structure, symbiotic interactions between species, and buffering against moisture stress. Soil organic matter, humified material, and decaying wood are centers of microbial activity and can substantially diminish as a result of intense fire (Amaranthus 1989).

The NRCS rated the 26 soils found within the fire perimeter, and their components, for the potential for seedling mortality (see Appendix H, Table FOR-5). The majority of soils rate as having low potential for seedling mortality. Soil 124F (Medco) rates as having a high potential for seedling mortality. All other soils with Medco as a component also are rated as high for the Medco percentage of those soils: 35 percent of 118E, 35 percent of 119F, 50 percent of 125F, and 55 percent of 126F.

Post-fire

Wildfire and forest management impacts to site productivity include:

- Reduced amounts of organic matter and mineral nutrients lost by fire consumption and erosion.
- Reduced water storage by removal of large woody material.
- Loss of productive soil by surface erosion and mass wasting.
- Reduced duff, litter, large organic matter, and associated nutrients.
- Concentration of runoff water by roads, landings, and yarding corridors.
- Removal of soil anchoring vegetation.
- Changes in water quality and stream sedimentation due to mass wasting and surface erosion.
- Increased subsurface water availability resulting from reduced evapotranspiration.

Soil nutrients are lost naturally because of leaching, burning, surface erosion (particularly water erosion), and mass wasting. Leaching and erosion are usually the major pathways of nutrient loss. Fires can volatilize both nitrogen (N) and sulfur (S) and, through wind-blown removal of ash, cause considerable nutrient losses. Hot wildfires may remove greater than 500 kg/ha (kilograms per hectare), or 5.6 percent, of the total nitrogen (8,775 kg/ha) in an ecosystem (Edmonds 1989, 27).

The majority of soils within the burn perimeter have high rock content (greater than 35 percent). Distribution of organic matter is found at a greater depth in rocky soils than in rock-free soils (Childs 1990, 97), conceivably protecting it from consumption by the fire.

In areas of high burn severity, the microbial and fungal populations have been substantially diminished. Given time, these species would migrate back into these sites from less severely burned areas, and from mycorrhizae inoculated tree planting under the alternatives.

Fires affect productivity by reducing the amount of organic matter on a site, which in turn alters the way a site cycles nutrients between living vegetation and decaying organic matter on the forest floor. Fires increase the nutrients available for immediate use by plants that colonize a site after fire. Fires also decrease the total amount of some nutrients stored in organic matter. Over time, as vegetation returns, nutrient levels increase and eventually reach pre-burn levels.

In areas of high burn severity, very little litter and duff remain on the forest floor. The loss of organic matter upon and within the soil reduces moisture-holding capacities, decreases soil aggregate stability, increases surface runoff, and depletes much of the soil nutrients. Remaining large pieces of down woody material tend to be heavily charred with a weather-resistant charcoal coating that slows the rate of natural decomposition and mineralization.

Various components of total organic matter (soil organic matter, litter and duff, and trees and shrubs) contribute in different ways to forest productivity. Soil productivity, as influenced by total organic matter, was substantially reduced by the fire. Losses of soil organic matter, litter, and duff reduced productivity by lowering total site moisture capacity and nutrient availability. Nitrogen availability and the presence of mycorrhizae that contribute directly to forest growth was also negatively affected. As much as 22 percent of the total organic matter was consumed in areas of the Silver Fire burned with high severity (USDA 1988, C-4-7)(see Table 3.3-7).

Where much of the forest canopy is lost, evapotranspiration and interception of rainfall would be greatly reduced. Where surface litter and duff layers were consumed and mineral soils exposed, infiltration and soil water storage would also be reduced. Increased water yield, sedimentation, and streamflow would occur in areas where the fire burned at high and moderate levels of severity.

Typically, soil types on the BLM-administered portion of the Timbered Rock Fire would have a maximum of one-inch surface cover of needles, twigs, and leaves but the wildfire consumed most of the soil organic matter in areas burned with a moderate and/or high burn severity. An in-depth soil organic matter study on the Silver Fire (USDA 1988, C-4-7), also located in Southwest Interior Oregon, is summarized in

Table 3.3-7. Pre- and Post-fire Organic Matter Distribution in the Silver Fire

	Pre-Fire	Post-fire		
		High Severity	Moderate Severity	Low Severity
Above Ground (bole)	41%	41%	41%	41%
Above Ground (tops, limbs, and brush)	16%	5%	10%	14%
Surface (duff and litter)	6%	1%	1%	3%
Below Ground (roots and organic matter)	37%	31%	34%	35%
Total Organic Matter	100%	78%	87%	92%
Organic Matter Lost	-	22%	13%	8%

Source: USDA 1988, C-4-7

Table 3.3-7.

Coarse woody debris (CWD) contributes to forest productivity by functioning as moisture and nutrient reservoirs and as habitat for both forest macro and microorganisms. Decomposing material would eventually breakdown to become surface litter and soil organic matter. CWD would also contribute to the bank stabilization of smaller streams and improve the fish habitat in larger streams. The overabundance of CWD on site may cause high fuel loads leading to future high intensity wildfires.

Although the fire increased the loss of organic matter, it also increased the supply of large woody material to the site over time as dead and dying trees continue to fall. Trees 8 to 19" DBH may stand 30-60 years in decay class 4 (Maser 1988, 28). Snags larger than 19" DBH may stand 51-125 years in decay class 4 (see Appendix K for snag decay class information). Therefore, trees in progressively larger DBH classes should fall at progressively later times. As plant succession proceeds, the disturbed site would revegetate, root strength would be restored, evapotranspiration would be increased, and soil water storage would be increased. However, the volume of organic matter input would still be severely reduced. Few large trees, the major source of large woody material, survived the fire in areas of moderate and high burn severity. The recruitment of future class 1 and 2 coarse woody material would take decades. Total organic matter would be reduced until the forest returns to vegetative diversity and maturity of pre-fire conditions, about 80 years.

3.3.3 Environmental Consequences

3.3.3.1 Mass Wasting – Uplands

- Six times higher incidence of mass wasting (landslides) in the moderate and high burn severity areas within the next decade.
- Areas at high risk are: planar slope morphology greater than 75% and concave slope morphology greater than 60%.
- Sediment delivered to the streams from steep slopes in high and moderate burn severity areas would be 500 to 1,000 tons per year over the next decade. Note: The natural, background sediment delivery for the entire watershed was estimated at 3,250 tons per year.

A review of scientific literature indicates management activities (slash burning, timber harvesting, and associated skid trails), or large-scale fires have a tendency to increase mass movement, especially in steep mountainous terrain, on concave slope morphology, and at the headwalls of inner gorges. The increased failure rates were estimated between two and four times higher than undisturbed areas. Removal of live trees from steep mountainous slopes with shallow soil depths affects the slope stability through (a) reduced evapotranspiration (ET) and subsequent increase in soil moisture and saturation, (b) reduced root strength, and (c) changes in surface drainage patterns and water concentration in a disturbed area. The incidence of in-unit landslides is relatively minor when compared to road-related landslides in the same areas, and is concentrated primarily on slopes over 50 percent (Haughe, et al. 1979).

The major factors affecting slope stability of an area are slope, physical properties of underlying soil, depth of groundwater within the soil layer, and vegetation. Available existing information was used to perform the relevant analyses.

The levels of groundwater are related proportionally to rainfall and its duration. For deep-seated landslides and

earth flows, the fluctuation of the groundwater (recharge) extends over several years, even decades. In areas with predominately shallow soils, the ground water fluctuations are seasonal and more immediate.

Hill-slope hydrological and erosional processes are strongly influenced by vegetation. Vegetation affects the slope hydrology, erosion, and slope stability. A sizable alteration of vegetation in a watershed (e.g. clearcutting or wildfire) increases stream flows, erosion, and the occurrence of landslides. These effects last on the order of decades (Adams, et al. 1994). With the exception of the upper Elk Creek Watershed administered by the US Forest Service, about 80 percent of the remaining watershed area had some level of harvest between the 1970s and 1990s (Boise 1999, Map 4). Past tree harvesting within the watershed, including thinning, partial cuts, and regeneration harvest, produced a cycle of weakened slope stability conditions due to reduced evapotranspiration and root strength. Little additional mass wasting can be expected in these areas as a result of post-fire tree salvage.

The incidence of mass wasting in the fire area, specifically in the high and moderate burn severity areas, would increase in the short-term (next 2 to 5 years). Documented evidence indicates the in-unit mass wasting in the Burnt Peak Fire area within the watershed was approximately six times higher than in the rest of the watershed. The mass wasting was primarily in the form of shallow rapid slides and torrents (Boise 1999, A-27).

In order to assess the relative risks associated with shallow translational landslides, the Level I Stability Analysis (LISA) model was employed in the assessment (Hammond, et al. 1992). The parameters that affect stability (soil depth, ground slope, tree surcharge, root strength, pertinent soil strength properties, and the fluctuations of ground water) were selected based on geology and soil mapping contained in the Boise WA. Field evaluation and in situ soil measurements were also made in critical upland areas within the burn area. Simulations of before and after fire, i.e. with and without the effects of root reinforcement of the soil, were performed.

Two distinct geomorphic landforms were analyzed:

- Planar and convex slopes – shallow soils, without groundwater concentration
- Concave, draw slopes – deeper soils, with groundwater concentration

Following the geotechnical analysis, an on-the-ground review and verification was conducted in order to verify the validity of the analysis. For details of the slope stability analysis see Appendix H, Soils.

The results of the slope stability analysis indicate the following:

- Higher incidence of shallow debris landslides would occur in high severity burn areas with planar or convex slopes exceeding 75 percent and in areas with concave slopes (draws) exceeding 60 percent.
- The area with “high potential risk” was estimated at less than 100 acres on BLM-administered lands (see Map 3-2, High Risk Landslide Potential).
- The timing of the mass wasting events would be directly dependent on rainfall intensity and duration during the first decade after fire.
- The estimated number of mass wasting events would be 30 to 40 within the next decade based on the proportionality of mass wasting events following the fire in the Burnt Peak Fire area.
- The total expected amount of sediment delivered from all these events would range between 122,000 cubic yards (yd^3) and 162,000 yd^3.

The size of the Timbered Rock Fire area is approximately 10 times larger than the size of the Burnt Peak Fire area. Proportionally, the volume of sediment delivered to the streams as a result of upland mass wasting within the Timbered Rock Fire area is expected to be 120 to 160 thousand cubic yards, or 1.0 to 1.5 yd^3/acre-year, within the next 8 to 10 years. The affected subwatersheds (HUC 6) would be Sugarpine Creek, Elk-Flat and Lower Elk (Rogue), in which the burn severity was the greatest.

The most notable effects from the mass wasting beyond the landslide areas would be to the stream channels and water quality. Approximately 70 percent of slides initiated along the uplands delivered sediment into streams (Boise 1999, A-15). Roads located below the unstable areas would also be negatively impacted by the upland mass movement, and would be closed to traffic. Areas most vulnerable to upland mass wasting would be located directly below the steep slopes (see Map 3-2, High Risk Landslide Potential).

Effects of Alternative A (No Action) and B on Mass Wasting - Uplands

Salvage Effects of Alternatives A and B

Direct and Indirect Effects

Under Alternatives A and B, there would be no salvage harvesting from the upland areas on BLM-administered lands.

Restoration Effects of Alternative A

Direct and Indirect Effects

Improvement of slope stability along the steep lands would be attributed to the reforestation occurring under the ESRP, especially when conducted in areas with steep slopes (over 75 percent).

Cumulative Effects

The following anticipated effects resulting from the Timbered Rock Fire would occur over the next 10 years, if preventive actions were not taken.

The total background sediment delivery from mass wasting and soil creep in the Elk Creek Watershed was estimated at 3,250 tons per year (Boise 1999, B-7). This translates to approximately 0.6 yd^3 of sediment per acre per year for the entire Elk Creek Watershed. In comparison, the cumulative averages of sedimentation for Steamboat Creek, a subwatershed of the Umpqua River, was assessed at 1.4 yd^3/acre per year, and for the Coastal Range the estimate is 0.45 yd^3/acre per year (Benda 1990). In a study conducted by Oregon Department of Forestry in 1999, the sediment delivery was assessed at 9.9 yd^3/acre per year for a large, 100-year event (1996). This implies a major natural event, such as large rain event or a large-scale fire, results in a ten-fold increased occurrence of mass wasting events.

BLM-administered lands burned at a high and moderate severity is 987 acres and 2,715 acres respectively, or 4 percent of the entire Elk Creek Watershed.

The industrial forest lands occupy approximately 41 percent of the fire area. The areas impacted by high and moderate burn severity contain 1,744 acres and 4,326 acres respectively, or 7 percent of the Elk Creek Watershed. The salvage plan on these private lands includes a salvage harvest on approximately 6,000 acres, or 7 percent of the entire Elk Creek Watershed area.

As a result of the Timbered Rock Fire, the expected number of mass wasting incidents would be six times higher than the natural background sediment delivery from mass wasting, or 100 thousands cubic yards more, within the 2 HUC 6 watersheds affected by the fire: Sugarpine Creek and West Branch Elk Creek. Compared to the background sediment input from mass wasting, the expected sediment input from upland mass wasting would approximately double, from 0.6 to 1.2 yd^3/acre per year. The increase would be expected to last 3-10 years, and diminish thereafter. As the upland areas recover over the next 20-30 years, the frequency of mass wasting would return to the pre-fire occurrence rates.

Based on engineering slope stability analysis, approximately 3 to 5 percent of the landscape contains slopes considered “at risk,” i.e. having unacceptable probability of mass wasting occurrence. This high-risk area is between 200 and 400 acres (BLM and private), or 0.3 and 0.5 percent of the entire Elk Creek Watershed area.

When considered on a large scale (HUC 5 field level), the upland mass wasting occurrence and sediment delivery from the fire region is not assessable in practical terms because of the small size, compared to the other mass wasting processes, although some visible, upland mass wasting could be observed.

A reasonable assumption for industrial forest lands, confirmed by visual observation, is that all merchantable trees have been or will be removed from these lands, including riparian areas. As a consequence, the mass wasting within these riparian areas and the adjacent steep slopes would be devoid of a large wood component (large woody debris, LWD). Consequently, the stream channels below these areas would be deprived of LWD, leading to simplified channels and less aggraded portions of the streams in the long term.

Among concerns related to mass wasting from the uplands are:

- Impact of mass wasting on transportation and system (roads) in the form of landslides terminating at roads.
- Impact of mass wasting on streams and riparian areas.

Effects Common to Alternatives C, D, E, F, and G (Preferred Alternative) on Mass Wasting - Uplands

Salvage Effects of Alternatives C, D, E, F, and G

Direct, Indirect, and Cumulative Effects

Alternatives C, D, E, F, and G propose salvage harvesting of fire-killed trees (snags) to varying degrees and with varying harvesting methods. Between .25 and 1.5 miles of new, temporary roads would be constructed along ridge tops. Many of these roads already exist as skid roads from old entries. These roads would be decommissioned after the timber haul is completed.

As related to landslide hazards, the direct, indirect, and cumulative effects of the removal of fire-killed trees from upland areas affected by high numbers of fire-killed trees would be quantitatively indistinguishable from the No Action Alternative.

The number of left snags and the differing levels of coarse woody debris (CWD) proposed under the action alternatives would have no impact on the incidence of mass wasting along the uplands.

The proposed temporary roads would be located along geologically stable ridge tops. Small cuts and fills characterize these roads. The probability of occurrence and any consequences would be numerically small, and practically insignificant. These roads would be fully decommissioned after the haul.

On private lands, the proposed construction of new roads within the fire area was estimated at 4 miles in 2002, and 3 miles in 2003. The proposed road treatments include on-going road maintenance and mulching of low-use roads. Since the design and construction standards are not known, the effects cannot be assessed.

Restoration Effects of Alternatives B, C, D, E, F, and G

Direct, Indirect and Cumulative Effects

The proposed restoration activities within the units consist of varying levels of thinning, reforestation, wildlife habitat projects, and fuel treatments.

In the short-term (next decade), the proposed restoration activities would have no effects on the incidence of mass wasting in the watershed.

In the long-term (next several decades), the proposed reforestation of high and moderate burn severity areas on BLM and private lands will improve the slope stability and reduce the occurrence and effects of mass wasting, especially on the 92 acres of lands identified as having high risk landslide potential (see Map 3-2). The slope stability analysis indicates the changes in slope stability between forested and denuded uplands (see Appendix H).

Exclusion of harvesting in the "high risk" areas, may, in the long-term, contribute to delivery of LWD, even though the incidence of mass wasting would remain the same. "High risk" areas are slopes where the probability of mass wasting exceeds 20 percent (draws with slopes greater than 65 percent, and greater than 75 percent for the remaining upland areas), and areas within 300 to 400 feet of perennial and intermittent streams.

3.3.3.2 Debris Torrents

- Anticipated direct and indirect effects are a direct result of the Timbered Rock Fire, and are not associated with any management activities.
- Channels with gradients exceeding 35% located in the moderate and high burn severity areas have the highest potential risk of debris torrents.
- The expected incidence of debris torrents would increase approximately ten-fold over the next 3-5 years in the fire area.

The incidence of debris torrents increases substantially following a large-scale fire in a watershed, primarily due to large increases in peak flows in the stream channels and draws in the fire areas. Large-scale fires have essentially the same effects on the incidence of debris torrents as large-scale harvesting.

The mechanics of a debris torrent are notably different from that of a landslide. Increased pore pressures within the soil mass trigger landslides. Torrents are initiated by either "critical stream discharge", i.e. unusually large increase in stream flow (Bovis, et al. 1985), or "hillslope failure" which delivers a large volume of loose soil and debris to a channel (Reneau and Dietrich 1987), triggering a torrent. A "critical stream discharge" could be caused by a large increase of in-stream flows after a major rain event, a large-scale fire within a watershed (peak flow increases between 100 percent and 200 percent), or a large-scale clearcutting (peak flow increases between 25 and 100 percent).

A review of scientific literature indicates the following:

- Torrents initiate in channels with gradients between 36 and 58 percent (Benda 1990).
- Transportation and erosion occur at channel gradients greater than 18 percent (Hungr, et al. 1984).
- Deposition started at channel gradients between 14 percent and 21 percent (Hungr, et al. 1984).
- Travel distances of torrents averaged 1,500' (Benda 1990).

Debris torrents comprise 44 percent of all mass wasting events in the Elk Creek Watershed (Boise 1999, A-14). The steep topography in the Burnt Peak area was particularly affected by debris torrents resulting from the 1987 fire.

A sediment transport and slope stability analysis indicates the most vulnerable areas related to the debris torrent hazard would be channels in steep topography, with channel gradients greater than 35 percent, and in areas that experienced high to moderate burn severity (see Appendix H).

These areas are located in:

- Flat Creek – Sections 18, 20, 28, 29
- Middle Creek – Sections 29, 30, 32, 33
- Alco Creek – Sections 5, 32
- Hawk Creek – Sections 3, 4 10
- Timber Creek – Sections 8, 9

Debris torrents are recognized as the primary means of delivery of complex sediment and debris to streams, which benefits the long-term health of the riparian areas and fisheries.

Coarse-grained sediment and organic debris are considered highly beneficial to the riparian resources along the lower reaches of streams in the watershed. The delivery path is blocked or altered by road stream-crossings when the debris torrent initiates above the stream-crossing. The drainage structures under the road fills are not designed to accommodate the peak flows and sediment and debris transported within the channels. As a result, water is either diverted out of the channel or flows over the top of the fill. Road fill failures are associated with the debris torrents.

Effects of Alternatives A (No Action) and B on Debris Torrents

Salvage Effects of Alternatives A and B

Direct and Indirect Effects

Under Alternatives A nad B, there would be no removal of trees (salvage harvesting) from the upland or riparian areas on lands managed by the BLM. Anticipated effects are a direct result of the Timbered Rock Fire and are not associated with any management actions.

Restoration Effects of Alternative A

Direct and Indirect Effects

Alternative A would have no effect on debris torrents.

Cumulative Effects

Large portions of the mass wasting events identified in the Elk Creek Watershed were debris torrents. Out of the total of 112 mass wasting events identified in the Elk Creek Watershed, 54 (48 percent) were debris torrents associated with uplands and roads (Boise 1999, Table A-3).

The total number of debris torrents in the Burnt Peak Fire was 18 (13 road-related and 5 non road-related) in an area comprising only 5 percent of the entire watershed.

The Timbered Rock Fire area is approximately 10 times larger than the Burnt Peak Fire area. The area with high and moderate burn severity is approximately three to four times larger. Proportionally, the projected number of debris torrents in the Timbered Rock Fire perimeter would range between 15 to 20 along uplands, and 40 to 50 associated with roads. The projected time frame for the increased debris torrent frequency is the next two to five years.

Among concerns related to debris torrents originating in the uplands are:

- Impact of torrents on road stream-crossings – drainage obstruction and subsequent road failure.
- Out-of-channel diversion of streams at road stream-crossings.

In order to mitigate these concerns, more frequent road maintenance in the moderate and high burn severity areas is needed.

Effects of Alternatives C, D, E, F, and G (Preferred Alternative) on Debris Torrents

Salvage Effects of Alternative C, D, E, F, and G

Direct and Indirect Effects

Alternatives C, D, E, F, and G propose salvage harvesting of dead trees (snags) to varying degrees and extents, and with varying harvesting methods. A total of 0.9 miles of new, temporary roads would be constructed along ridge tops. Alternative G (Preferred Alternative) proposes construction of nine segments of temporary roads totaling 0.9 miles. These road spurs would be constructed along geologically stable ridge tops. Field assessment and slope stability analysis indicates there is no potential for mass wasting from these temporary roads and, therefore, no effects on debris torrents would be expected. These roads would be decommissioned after the timber haul is completed.

The direct and indirect effects of fire-killed tree removal from upland areas affected by high tree mortality due to the fire (high and moderate burn severity) are quantitatively indistinguishable from the direct and indirect effects of the No Action Alternative. The incidence of debris torrents would be independent of the level of salvage harvest on BLM-administered or privately held lands.

Restoration Effects of Alternatives B, C, D, E, F, and G

Direct, Indirect, and Cumulative Effects

The proposed restoration activities within the units consist of varying levels of thinning, reforestation, wildlife habitat projects, and fuel treatments.

The proposed restoration activities will have no effects on the incidence or timing of debris torrents in the Timbered Rock Fire area and in the Elk Creek Watershed. The effects would be quantitatively indistinguishable from the direct, indirect, and cumulative effects of No Action Alternative.

In practical terms, no effective actions along the uplands would be possible to prevent the occurrence and reduce the effects of debris torrents along the uplands where high and moderate burn severity occurred.

Exclusion of harvesting in the “high risk” areas may, in the long-term, contribute to delivery of LWD to the streams, even though the incidence of mass wasting would remain the same.

3.3.3.3 Mass Wasting – Roads

- Stream crossing fills have a high potential for failure when located on slopes greater than 30%.
- The condition of the majority of the stream crossings within the fire area is unsatisfactory, i.e. inadequate drainage size, condition of the drainage structure, fill stability, etc.
- Between 40 and 60 miles of mid-slope roads within the Timbered Rock Fire perimeter are considered “at risk”.
- Eighteen stream crossings were identified to be at this risk level; they contain approximately 13,000 cubic yards of fill material.

Road building in steep mountainous terrain has been long recognized as the single greatest cause of soil mass movement (Swanston 1970). The increased rates of failure were assessed at 25 to 400 times the rates of failure for undisturbed terrain (Sidle, et al. 1985). Sedimentation resulting from roads has the most negative impact on water quality and aquatic habitats. Road fill failures in and near riparian areas deliver undesirable sediment (predominately fine-grained soil) into streams. The most important factors affecting the landslide hazards of roads in mountainous terrain are road location and drainage. Mid-slope roads located in a steep terrain have the greatest incidence of landslides caused by fill and cut bank failures. The main causes of failures are poorly constructed fills, inadequate drainage (number and size), and lack of maintenance.

Effects of Alternative A (No Action) on Mass Wasting - Roads

The junctions of perennial or intermittent streams with road stream-crossings have the highest potential for negative impacts. Failures cause disruption of land access, cost money to rebuild, deliver substantial amounts of "undesirable" sediment, both in quality (fines) and quantity (an increase of 200 percent above background), and would have negative impact on stream conditions below the crossings. A slope stability analysis was conducted in order to assess the relative potential for mass wasting at these sites (see Appendix H, Slope Stability Analysis – Road Fill Failures) for the results of the analysis.

Stream-crossings located along steep, mid-slope roads pose the greatest failure hazard on the landscape. The road fills are likely to perform as "dams" during major flow events, when the drainage structure becomes partially and fully plugged with sediment and wood debris. The standard road design and construction practices do not allow for this worse case scenario – plugged culvert and full inundation of the fill. The most vulnerable stream-crossings would be located in or below moderately to high burn severity areas, along steep slopes, and in areas with the greatest potential impacts to natural resources (fish). Stream-crossings at highest risk are located in the Timber Creek (Section 9), Flat Creek (Section 29), Middle Creek (Section 29), and Alco Creek (Sections 5 and 31) subwatersheds. Eighteen stream-crossings containing approximately 13,000 cubic yards of fill material, were identified to be at this risk level.

Mass wasting along the cut banks and road fills, in the form of sloughs, are numerous and predictable. The incidence would be tied to the steepness of the ground, height of the cutbank or fill slope, and local geology and geomorphology of the area. Assuming 60 to 70 percent of all roads are mid-slope roads, and 15 to 20 percent of the Timbered Rock Fire area has slopes steeper than 65 percent (see Table 3.3-2), the number of road miles considered "at risk" would be between 40 and 60, or 10 to 15 percent of all roads within the fire perimeter.

The number of road-related shallow rapid slides within the Burnt Peak Fire perimeter was assessed at 12 (Boise 1999, Appendix A, Table A-3). The Timbered Rock Fire area is approximately 10 times larger than the Burnt Peak Fire area. Proportionally, the number of road-related landslides that would likely occur within the Timbered Rock Fire area would range between 80 and 100.

Salvage Effects from Alterative A and B

Direct and Indirect Effects

Assessment of direct and indirect impacts of the No Action Alternative on mass wasting from roads in the salvage areas (upland) would be the same as 3.3.3.1 Mass Wasting – Uplands.

Restoration Effects of Alternative A

Direct and Indirect Effects

No restoration projects are proposed. Alternative A would have no affect on mass wasting from roads.

Cumulative Effects

Of the 125 mass wasting incidents identified in the Elk Creek Watershed, 68 (54 percent) were road-related. Disproportionate numbers of road-related landslides were identified in the Burnt Peak Fire area, as a result of large-scale fire in 1987. A total of 25 slides (20 percent) were noted in an area occupying approximately 5 percent of the entire watershed area (Boise 1999, Appendix A, Table A-3). Considering the size of the Timbered Rock Fire is approximately 10 times larger than the Burnt Peak Fire area, the total number of road-related mass wasting events over the next decade could be expected to be between 200 and 250.

The total number of road stream-crossings in the Elk Creek Watershed is about 2,500, containing an estimated 460,000 yd^3 of fill material. The Timbered Rock Fire area is 27,100 acres large, or 32 percent of the Elk Creek Watershed. Proportionally, the number of stream-crossings contained within that area is approximately 800, with 150,000 yd^3 of material. The analysis indicates that 44 of the stream-crossings on BLM-administered lands are at high or moderate risk of failure. Another 40 to 50 stream-crossings at high or moderate risk are estimated to be located on private lands.

Among concerns related to mass wasting along roads are:

- Loss of land access and delivery of undesirable quality and quantity of sediment into the streams from failed high-risk road stream-crossings.
- Out-of-channel diversion of streams at road stream-crossings and subsequent out-of-channel landslides.
- Numerous road cutbank and fill failures and associated loss of access and sediment delivery into streams.

Effects of Alternatives B and F on Mass Wasting - Roads

Salvage Effects of Alternative F

Direct, Indirect, and Cumulative Effects

Assessment of direct and indirect impacts of Alternative F on mass wasting from roads in the salvage areas (upland) would be the same as Section 3.3.3.1 Mass Wasting – Uplands.

Restoration Effects of Alternatives B and F

Direct and Indirect Effects

Restoration activities under these alternatives are limited to within the Timbered Rock Fire area, and focus primarily on anthropogenic disturbances in the landscape. Only sites assessed to be at high-risk of mass wasting, and road segments in high-risk areas (high and moderate burn severity and steep topography) would be restored. The treatment strategies would include reconstruction of at-risk stream-crossings, storm-proofing roads, disconnecting roads from streams, and decommissioning roads. In Alternative B, road decommissioning would occur outside the fire perimeter.

The activities would be comprised of road segment treatments, as well as site-specific road treatments. Under Alternative B, 15 miles of road would be decommissioned and 100 miles would be maintained. In Alternative F, 17 miles of road would be decommissioned and 68 miles would be maintained. Also, 15 high risk sites (stream-crossings) in Alternative B, containing approximately 11,000 yd^3 of sediment, and 26 stream-crossings in Alternative F, containing approximately 19,000 yd^3 of sediment, would be reconstructed (see Table 2-1, Comparison of Alternatives).

The road segments and specific sites proposed for restorative treatments are displayed on Map 3-3b and in Appendix E.

Proposed road restoration activities would result in considerable reduction of the potential mass wasting and erosion hazards primarily related to stream-crossings. The total reduction in the acute sediment delivery to the streams from the at-risk sites would be approximately 30,000 yd^3, in the Timbered Rock Fire area. The above quantities would be in addition to the actual and potential reduction of fine sediment from the chronic erosion of road surfaces.

The actual and potential reduction of the chronic and acute sediment delivery from the restoration activities would be helpful in reestablishing the natural post-fire quality, quantity, and timing of sediment delivery to the streams.

Cumulative Effects

The background, natural sedimentation for the entire Elk Creek Watershed was estimated at 3,250 tons/year (Boise 1999, B-20, Table B-11), or approximately 2,400 yd^3 of delivered sediment per year. The mass wasting along roads was assessed at 6,970 tons/year, or approximately 5,200 yd^3 per year. Compared to Alternative A (No Action Alternative), the proposed restoration projects would result in elimination of the potential sources of sediment over the next 5 to 8 years. The reduction of potential sources of mass wasting would be approximately 30,000 yd^3 of sediment, or 16 percent of the total potential mass wasting from roads, assuming 5 percent annual fill failure rate for the high risk stream-crossings, and 1 percent rate for the removed fills.

Based on information obtained from private landowners, an additional 7 miles of new roads were constructed within the fire area in 2002 and 2003. Oregon Forest Practices Act (FPA) regulates road building and maintenance on private lands. These rules apply to all management activities in the forest and were developed to protect forest resources, including mass wasting, erosion, and water quality standards.

Effects of Alternatives C, D, and G (Preferred Alternative) on Mass Wasting - Roads

Salvage

Direct and Indirect Effects

Assessment of direct and indirect impacts of Alternatives C, D, and G on mass wasting from roads in the salvage areas (upland) would be the same as Section 3.3.3.1 Mass Wasting – Uplands.

Restoration

Direct and Indirect Effects

Proposed restoration projects related to mass wasting along roads would include culvert replacement, road reconstruction and decommissioning, and stream-crossing reconstruction.

The goal of the proposed road restoration would be to improve the quantity, quality, and timing of anthropogenic sediment delivery to the streams. For this purpose, sensitive environmental and land management indicators were identified and analyzed.

Among the important factors were:

- Sensitive geology and geomorphology.
- Road location.
- Fire intensity and location.

The treatment strategies would include: stabilizing at-risk stream-crossings, storm-proofing roads, disconnecting roads from streams, and decommissioning of unused roads, prioritized by risk of failure.

The proposed road restoration actions would be the same under Alternatives C, D, or G with small variations in the length of road treatments. The restoration activities would be proposed inside and outside the Timbered Rock

Fire perimeter. The activities would be comprised of road segment treatments, as well as site-specific road treatments.

About 100 miles of road would be maintained and 35 miles of roads would be decommissioned. Also, 11 high risk sites (stream-crossings), containing approximately 8,000 yd^3 of sediment would be reconstructed, and 133 stream-crossings, containing approximately 50,000 yd^3 of sediment, would be removed (see Table 2-1, Comparison of Alternatives).

The road segments and specific sites proposed for restorative treatments are displayed the Map 3-3b and in Appendix E.

The proposed road restoration activities would result in substantial reduction of the potential mass wasting and erosion hazards primarily related to stream-crossings. The total reduction of acute sediment delivery to the streams from at-risk sites would be between 35,000 yd^3 to 40,000 yd^3 in the Timbered Rock Fire area, and another 15,000 yd^3 to 20,000 yd^3 outside the fire area. The above quantities would be in addition to the actual and potential reduction of fine sediment from the chronic erosion of road surfaces.

The actual and potential reduction of the chronic and acute sediment delivery from the restoration activities would be effectual in reestablishing the natural post-fire quality, quantity, and timing of sediment delivery to the streams.

Cumulative Effects

The background, natural sedimentation for the entire Elk Creek Watershed was estimated at 3,250 tons/year (Boise 1999, B-20, Table B-11), or approximately 2,400 yd^3 of delivered sediment per year. The mass wasting along roads was assessed at 6,970 tons/year, or approximately 5,200 yd^3 per year. Compared to Alternative A (No Action Alternative), the proposed restoration projects would result in elimination of the potential sources of sediment over the next 5 to 8 years. The reduction of potential sources of mass wasting would be 50,000 yd^3 of sediment, or 23 percent of the total potential mass wasting from roads, assuming 5 percent annual fill failure rate for the high risk stream-crossings, and 1 percent rate for the removed fills

Based on information obtained from private landowners, an additional 7 miles of new roads were constructed within the fire area in 2002 and 2003. Oregon Forest Practices Act (FPA) regulates road building and maintenance on private lands. These rules apply to all management activities in the forest and were developed to protect forest resources, including mass wasting, erosion, and water quality standards.

Effects of Alternative E on Mass Wasting - Roads

Salvage

Direct and Indirect Effects

Assessment of direct and indirect impacts of Alternative E on mass wasting from roads in the salvage areas (upland) would be the same as Section 3.3.3.1 Mass Wasting – Uplands.

Restoration

Direct and Indirect Effects

Under Alternative E, the treatment strategies are reconstruction of at-risk stream-crossings, storm-proofing roads, disconnecting roads from streams, and decommissioning roads for all sites and road segments considered to be at risk, regardless of the degree of risk.

The restoration activities proposed in Alternative E would be undertaken inside and outside the Timbered Rock Fire perimeter. The activities would be comprised of road segment treatments, as well as site-specific road treatments. There would be 115 miles of road maintained and 43 miles of roads decommissioned. Also, 26 high risk sites (stream-crossings), containing approximately 19,000 yd^3 of sediment would be reconstructed, and 148 stream-crossings, containing approximately 44,000 yd^3 of sediment, would be removed (see Table 2-1, Comparison of Alternatives).

The road segments and specific sites proposed for restorative treatments are displayed on Map 3-3b and Appendix E.

The proposed road restoration activities would result in substantial reduction of the potential mass wasting and erosion hazards that are primarily related to stream-crossings. The total reduction in the acute sediment delivery to the streams from the at-risk sites would be between 50,000 yd^3 and 55,000 yd^3, in the Timbered Rock Fire area, and another 20,000 yd^3 to 25,000 yd^3 outside the fire perimeter. The above quantities are in addition to the actual and potential reduction of fine sediment from the chronic erosion of road surfaces.

The actual and potential reduction of the chronic and acute sediment delivery from the restoration activities would be helpful in reestablishing the natural post-fire quality, quantity, and timing of sediment delivery to the streams.

Cumulative Effects

The background, natural sedimentation for the entire Elk Creek Watershed was estimated at 3,250 tons/year (Boise 1999, B-20, Table B-11), or approximately 2,400 yd^3 of delivered sediment per year. The mass wasting along roads was assessed at 6,970 tons/year, or approximately 5,200 yd^3 per year. Compared to Alternative A (No Action Alternative), the proposed restoration projects would result in elimination

of the potential sources of sediment over the next 5 to 8 years. The reduction of potential sources of mass wasting would be 74,000 yd^3 of sediment, or 28 percent of the total potential mass wasting from roads, assuming 5 percent annual fill failure rate for the high risk stream-crossings, and 1 percent rate for the removed fills.

Based on information obtained from private landowners, an additional 7 miles of new roads were constructed within the fire area in 2002 and 2003. Oregon Forest Practices Act (OFPA) regulates road building and maintenance on private lands. These rules apply to all management activities in the forest and were developed to protect forest resources, including mass wasting, erosion, and water quality standards.

3.3.3.4 Soil Erosion

Effects of Alternative A (No Action) on Soil Erosion

Salvage

Direct and Indirect Effects

Under Alternative A, no salvage would occur.

Accelerated surface erosion would occur, particularly on steep slopes, where loss of vegetation and duff has exposed soils. The erosion rates would substantially increase over pre-fire rates as the soil is exposed to raindrop detachment and increased overland flows. Surface gravels would increase as soil particles are displaced. The soils on steep slopes would continue to erode and ravel at a high rate until new vegetation is established. Erosion rates would reduce as leaves, branches, and large woody debris accumulate, and as hydrophobicity decreases. This would be a short-term effect that would diminish as the fire perimeter revegetates.

Sediment yields from erosion in the fire perimeter would increase considerably over the pre-fire yield. Accelerated rates of erosion resulting in increased sedimentation may occur on extensively burned slopes adjacent to streams, inner gorges, talus slopes, and the steeper uplands.

As fire-killed roots decay, wind-throw would increase on those soils rated by the NRCS as having a severe wind-throw hazard. Wind-toppled trees would increase erosion rates by bringing the soil surrounding the roots to the surface. This could affect approximately 6,680 acres on soils 184G and 185G. An additional 60 acres on soils 119F and 124 F would have a moderate to severe wind-throw hazard.

Wind toppled trees are not effective in reducing erosion from hillslopes. Even when properly placed on contour, research has shown that at the watershed scale, log-erosion barriers may reduce sediment yield. However, most sediment came from channel erosion rather than hillslopes (Gartner 2002). Under some circumstances, the logs capture a significant proportion of the runoff, but under circumstances both lesser and greater in magnitude, the logs contributed little to sediment control.

Hydrophobic soils would break down naturally over the next one to four years, gradually decreasing the possibility of soil saturation and soil movement that results in sedimentation or landslides.
No new roads or skid trails would be built under Alternative A, therefore there would be no increase in erosion and sedimentation, as a result of road building.

One of the only replicated and controlled studies on erosion and salvage logging found there was no difference in sediment output between logged and unlogged units when using tractors and cable logging. The sediment contributed by logging was overwhelmed by the sediment produced as a consequence of the fire itself (Chou 1994, 498).

On the Eldorado National Forest, erosion rates were estimated to be 9 to 15 times greater on government-managed land that was not salvaged as compared to adjacent private lands salvaged immediately after the fire. This was due to the breaking up of hydrophobic soils that allowed infiltration of rain rather than overland flow (Poff 2002, B-14). Hydrophobic soils are not considered a major hydrologic concern on this project.

Restoration

Direct and Indirect Effects

Planting, the only restoration activity under Alternative A, was analyzed in the ESRP.

Long periods of protection from fire are associated with fuel buildup, which leads to litter depths greater than would be expected under a more natural fire regime. Consequently, an uncontrolled natural burn could be of such intensity as to severely increase erosion and sedimentation. This would be a long-term adverse effect.

Roads have been identified as the major source of sediment. Road projects would have reduced sediment from roads by up to 50 percent, consequently the high rate of road-related erosion would continue. No road projects would take place so a long-term adverse effect would result.

Since seasonal road closures would not occur under this alternative, use of nonsurfaced roads during the winter would continue to disturb soils. Effects would be local in extent and mitigated by riparian vegetation. This would be a moderate long-term adverse impact.

Cumulative Effects

Cumulative effects to the soil under the No Action Alternative would include the continuation of the natural rehabilitation and restoration. The soil erosion rates on low severity sites would stabilize in approximately 3-5 years

as vegetation reestablishes on the site. It may take up to 10 years for the erosion rates to stabilize in the high burn severity areas on steep slope. The potential risk of increased slumping and localized mass wasting would subside in about 10 years as root strength and soil cohesion resulting from soil organisms increases.

Approximately 11,140 acres of industrial forest lands within the fire perimeter burned. Of this, 2,060 acres were disturbed by tractor yarding, 3,255 acres by skyline yarding, and 410 acres by helicopter yarding. This salvage amounts to approximately 21.1 percent of the burn area and 6.7 percent of the watershed.

Generally, most trees were whole-tree yarded, leaving little organic material on the surface. It is estimated that 31 to 35 percent of the pre-fire organic material is still present on private lands that have been harvested. On non-harvested lands, 78 to 93 percent of pre-fire organic material remains.

Within the surrounding area, the BLM proposes two timber sales: Trail Creek and Flounce Around. Combined, these sales would impact 1,012 acres by tractor yarding, 248 acres by cable yarding, and 30 acres by use as helicopter landings. This would result in a maximum of 12 percent of the entered stands in a compacted and/or disturbed state. This disturbance would occur outside of the watershed.

During the Timbered Rock Fire, approximately 22.6 miles of tractor fireline and 9.8 miles of handline were constructed. All firelines were rehabbed with water bars and those on BLM-administered lands were seeded and had debris pulled back onto the line. Additionally, a staging area near Elk Creek was ripped and seeded.

Two additional fires occurred within the surrounding area: the Wall Creek Fire (313 acres) in the Trail Creek Watershed and the Berry Rock Fire (25 acres) within the Elk Creek Watershed. All firelines were rehabbed with water bars and those on BLM-administered lands were seeded and had debris pulled back onto the line.

Effects Common to Alternatives B, C, D, E, F, and G (Preferred Alternative) on Soil Erosion

Restoration

Direct and Indirect Effects

Culvert replacement would result in a slight, short-term increase in sediment. There would be a short-term negative and a long-term beneficial effect as sediment is quickly routed out of the system during periods of high peak flow.

There would be a slight, short-term increase in sediment during the installation of fish structures. Vegetation in Riparian Reserves would reduce this impact by limiting the amount of exposed soil. The degree of impact would be relative to the number of logs, weirs, and gravel deposits emplaced.

Commercial thinning would occur on 62 acres during the creation of FMZs. These FMZs are located primarily on ridgetops. The majority of skid roads needed for commercial thinning already exist from past entries. Distance from streams and filtering by riparian vegetation would reduce or prevent sediment from reaching streams.

Long periods of protection from fire are associated with fuel buildup, which leads to litter depths greater than would be expected under a more natural fire regime. Consequently, an uncontrolled natural burn could be of such intensity as to severely increase erosion and sedimentation. For this reason, proposed treatments are considered to have a net positive influence on soil resources. Soil erosion would experience a slight negative decrease short-term but long-term positive effects would be realized from the proposed actions as the risk of severe fire is diminished.

Bull-line and cable corridors would act as conduits for water and sediment movement. Water bars would be placed as needed and filtering by riparian vegetation would reduce or prevent sediment from reaching streams.

During proposed fuel treatments within owl activity centers, most soil movement would occur during the first season after the slash is burned and would quick diminish as vegetation cover reestablishes. Soil erosion would experience a slight increase short-term, but long-term positive effects would be realized from the proposed actions as the risk of severe fire is diminished.

Placement of six log piles for wildlife habitat by an excavator would slightly increase erosion rates. No detrimental erosion would result.

Decommissioning roads would decrease sediment yields to near natural rates after 10 years. There would be a moderate short-term increase in sediments yielded to local streams the first few rain events after road work is completed. This would be particularly evident if all of the road work is accomplished during the first year of the contract.

Fully decommissioning roads would return four acres of land to vegetation for each mile of road decommissioned (see Table 3.3-8). There would be a slight to moderate increase in soil disturbance. Effects would be local in extent and mitigated by riparian vegetation. This would be a slight, short-term adverse impact.

A slight to moderate increase in soil disturbance during road reconstruction and stream-crossing upgrades would have a slight, short-term adverse impact. Effects would be local in extent and mitigated by riparian vegetation.

Table 3.3-8. Acres Returned to Vegetation

Alternative	Miles of Road Fully Decommissioned	Acres Returned to Vegetation
B	32	128
C	32	128
D	32	128
E	38	152
F	15	60
G	32	128

Maintenance of roads would decrease by up to 46 percent the chronic sedimentation from BLM roads proposed for maintenance (see Table 3.3-9).

Pump chance reconstruction would have minimal soil disturbance in the immediate surrounding area. Effects would be local in extent and mitigated by riparian vegetation. This would be a slight, short-term adverse impact.

The closure and rehabilitation of rock quarries would cause effects local in extent that would be mitigated by riparian vegetation. This would be a slight, short-term adverse impact.

Table 3.3-9. Miles of Road Maintenance by Alternative

Alternative	Maintenance Miles
B	100
C	100
D	100
E	115
F	68
G	100

Effects of Alternative B on Soil Erosion

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur. Effects would be the same as Alternative A.

Restoration

Direct and Indirect Effects

Restoration effects would be the same as restoration effects common to Alternatives B-G, except for the following:

- No commercial thinning would occur.
- Thinning and clearing for eagle nesting habitat improvement without commercial removal would have no effect on erosion.
- Since seasonal road closures would not occur under this alternative, use of nonsurfaced roads during the winter would continue to disturb soils. Effects would be local in extent and mitigated by riparian vegetation. This would be a moderate long-term adverse impact.

Cumulative Effects

Cumulative effects under Alternative B would be the same as Alternative A.

Effects Common to Alternatives C, D, E, F, and G (Preferred Alternative) on Soil Erosion

Salvage

Direct and Indirect Effects

Research into erosion rates after fire and salvage is very sparse. In a literature review on the environmental effects of post-fire logging (McIver 2001, 162), several unreplicated studies found dramatically increased sedimentation rates following fire and salvage (Helvey 1980; Helvey 1985; McIver 2001, 162). One of the only replicated and controlled studies on erosion and salvage logging found that when using tractors and cable logging, there was no difference in sediment output between logged and unlogged units. The sediment contributed by logging was overwhelmed by the sediment produced as a consequence of the fire itself (Chou 1994, 498).

Other studies found post-fire logging had little effect on runoff or soil loss compared to that resulting from the wildfire only (Marston 1990, 6). Salvage logging can improve watershed conditions by adding ground cover (Poff 1989, 140). By creating patches of disturbed soil, post-fire logging can encourage more establishment of plant species relative to post-fire unlogged sites (McIver and Starr 2000, 63).

Salvage logging can improve watershed conditions by breaking up hydrophobic soils (Poff 1989, 140). The use of ground-based yarding systems may assist in disrupting the surface hydrophobic condition (Ice and Beschta 1999, 6). On the Eldorado National Forest, it was estimated erosion rates were 9 to 15 times greater on government-managed land that was not salvaged as compared to adjacent private lands salvaged immediately after the fire. This was due to the breaking up of hydrophobic soils that allowed infiltration of rain rather than overland flow as happened on the National Forest (Poff 2002, B-14).

Skyline and helicopter yarding would result in less erosion and sediment transport than tractor yarding. It is estimated skyline yarding subjects up to 5 percent of the unit to erosion and sediment transport. Helicopter yarding would subject about 3.4 percent of the unit to erosion and sediment transport, whereas tractor yarding and cable skidding would

effect 12 percent of the unit (Klock 1975, 80; as modified by BLM's practice of requiring designated skid trails).

During the three years following salvage, no accelerated erosion or sediment transport resulted when Best Management Practices were implemented. Salvage had a positive effect by increasing ground covered with slash (Maloney 1995,11).
Considerable surface soil erosion is likely to occur in the first five years following any damage to the soil and loss of vegetation caused by the fire. The first rainy season would probably see the greatest surface runoff and subsequent delivery of fine sediment and turbidity to the downstream aquatic system, with each of the following years becoming progressively less. It is likely any hydrophobic conditions would dissipate within the first few years after the fire.

Of proposed yarding systems, helicopter yarding would cause the least impact to the existing soil and would only slightly increase erosion rates. Building helicopter landings would disturb less than one acre of soil per landing near existing roads. These landings would be ripped and seeded upon completion of the project. Best Management Practices should minimize sediment reaching stream channels, depending on post harvest weather conditions.

Erosion rates in harvest units would be higher in the tractor units where the soil is disturbed and lower in the cable units. Although erosion rates would increase, most soil particles would remain on-site and very few soil particles would reach any waterways as filtering by vegetation in Riparian Reserves would prevent or reduce sediment from reaching streams.

There would be a short-term increase in soil movement along temporary spur roads, skid trails, and on cable yarding corridors before disturbed soils stabilize. Locating temporary roads on or near ridges, water-barring skid trails, and filtering by vegetation in Riparian Reserves would reduce or prevent sediment from reaching streams.

Skyline and bull-line corridors would act as conduits for water and sediment movement. Water-barring skid trails and filtering by vegetation in Riparian Reserves would reduce or prevent sediment from reaching streams.

Erosion rates would return to pre-fire levels within about three to five years depending on vegetation recovery, slope, and storm intensity.

Temporary spur roads would increase the existing erosion rates in the localized area of construction. Most of the eroded particles would not enter stream channels but would resettle on the hillslope.

The effects of timber salvage on erosion are primarily limited to surface erosion. Tree roots hold soil on steep slopes reducing the extent of mass movements, but roots of fire-killed trees likely decompose at the same rate as when a green tree is harvested. Surface erosion can occur from salvage harvesting similar to any harvest activity that includes road construction, skid trails, or yarding corridors. Site-specific conditions and harvest practices would strongly influence the magnitude and duration of surface erosion. Mitigation measures have been developed to reduce erosion, and these measures have been integrated into standard harvest practices (see Section 2.3.1.3 for Project Design Features).

Percents in Table 3.3-10 are based on a 1975 study by Klock, which generally involved clearcut with no pre-designated skid trails and no stream-side buffers. This represents a worst-case scenario and is presented only as a method to compare alternatives. Pre-designated skid trails would be required in the Timbered Rock Fire salvage. Additionally, roadside salvage in this project would often involve one to five trees per acre, with corresponding decrease in soil erosion.

Table 3.3-10. Erosion and Sediment Transport and Soil Displacement Rates from Salvage Yarding Systems

Yarding System	Erosion and Sediment Transport Rate	Soil DIsplacement Rate
Tractor	12%	12%
Bull-line	12%	12%
Cable	5%	2.8%
Helicopter	3.4%	0.7%
Roadside Salvage	12%	12%

In Riparian Reserves burned at high or moderate severity, vegetation is growing as of spring 2003. By spring 2004, it is estimated ground cover in Riparian Reserves will be partially reestablished. Filtering by vegetation in Riparian Reserves would reduce or prevent eroded sediment from reaching streams. The BLM hydrologist and soil scientist visited the Quartz Fire which has had two winters to heal. Riparian vegetation (grass, forbs, brush, and hardwoods) has started to reestablish and is in a recovering condition. Similar riparian vegetation growth is occurring in the Timbered Rock project area. This would cause a slight, short-term effect dispersed over the fire perimeter.

Cumulative Effects

Approximately 11,140 acres of industrial forest lands burned. Of this, 2,060 acres were disturbed by tractor yarding, 3,255 acres by helicopter yarding, and 410 acres by skyline yarding. This salvage amounts to approximately 21.1 percent of the burn area and 6.7 percent of the watershed.

A long-term decrease in sediment production to near natural levels would result from maintenance and decommissioning of existing roads. The rocking of about 24 miles of existing unsurfaced roads would further reduce sediments reaching the aquatic environment.

The cumulative effects to the soil resource in the affected landscape area would be a moderate short-term increase in erosion rates over pre-fire rates which would last about three to five years. This effect of salvage would be difficult to detect, as the sedimentation due to the fire is so great. A slight long-term decrease in erosion rates would occur as ground cover reestablishes in the affected harvest units, land once occupied by roads is put back into producing vegetation (ground cover), and the risk of severe wildfire is reduced. The watersheds would continue to experience high erosion rates long-term as a result of the high road density per square mile.

Effects of Alternative C on Soil Erosion

Salvage

Direct and Indirect Effects

Salvage effects under Alternative C would be the same as salvage effects common to Alternatives C-G.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative C would be the same as restoration effects common to Alternatives B-G, except for the following:

- Commercial thinning of late-successional forest habitat and pine restoration would have a slight negative effect on erosion; filtering by riparian vegetation would mitigate this impact.
- Thinning and clearing for eagle nesting habitat improvement without commercial removal would have no affect on erosion.
- Since seasonal road closures would not occur under this alternative, use of nonsurfaced roads during winter would continue to disturb soils. Effects would be local in extent and mitigated by riparian vegetation. This would be a moderate long-term adverse impact.

Cumulative Effects

Cumulative effects under Alternative C would be the same as cumulative effects common to Alternatives B-G.

Effects of Alternative D on Soil Erosion

Salvage

Direct and Indirect Effects

Salvage effects under Alternative D would be the same as salvage effects common to Alternatives C-G.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative D would be the same as restoration effects common to Alternatives B-G, except for the following:

- Commercial thinning of late-successional forest habitat and pine restoration would have a slight negative effect on erosion; filtering by riparian vegetation would mitigate this impact.
- Thinning and clearing for eagle nesting habitat improvement without commercial removal would have no effect on erosion.
- Since seasonal road closures would not occur under this alternative, use of nonsurfaced roads during winter would continue to disturb soils. Effects would be local in extent and mitigated by riparian vegetation. This would be a moderate long-term adverse impact.

Cumulative Effects

Cumulative effects under Alternative D would be the same as cumulative effects common to Alternatives C-G.

Effects of Alternative E on Soil Erosion

Salvage

Direct and Indirect Effects

Salvage effects under Alternative E would be the same as salvage effects common to Alternatives C-G.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative E would be the same as those common to Alternatives C-G, except for the following:

- Commercial thinning of late-successional forest habitat and pine restoration would have a slight negative effect on erosion; filtering by riparian vegetation would mitigate this impact.
- Thinning and clearing for eagle nesting habitat improvement without commercial removal would have no effect on erosion.

Cumulative Effects

Cumulative effects under Alternative E would be the same as cumulative effects common to Alternatives B-G.

Effects of Alternative F on Soil Erosion

Salvage

Direct and Indirect Effects

Salvage effects under Alternative F would be the same as salvage effects common to Alternatives C-G.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative F would be the same as restoration effects common to Alternatives B-G, except for the following:

- Since seasonal road closures would not occur under this alternative, use of nonsurfaced roads during winter would continue to disturb soils. Effects would be local in extent and mitigated by riparian vegetation. This would be a moderate, long-term adverse impact.

Cumulative Effects

Cumulative effects under Alternative F would be the same as cumulative effects common to Alternatives B-G.

Effects of Alternative G (Preferred Alternative) on Soil Erosion

Salvage

Direct and Indirect Effects

Salvage effects under Alternative G would be the same as salvage effects common to Alternatives C-G.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative G would be the same as restoration effects common to Alternatives B-G, except for the following:

- Commercial thinning of late-successional forest habitat and pine restoration would have a slight negative effect on erosion; filtering by riparian vegetation would mitigate this impact.
- Thinning and clearing for eagle nesting habitat improvement without commercial removal would have no effect on erosion.

Cumulative Effects

Cumulative effects under Alternative G would be the same as cumulative effects common to Alternatives B-G.

3.3.3.5 Soil Disturbance

Effects of Alternative A (No Action) on Soil Disturbance

Salvage

Direct and Indirect Effects

There is no salvage in Alternative A, therefore no additional impact to soil compaction on BLM-administered lands would occur.

Restoration

Direct and Indirect Effects

No restoration projects would be proposed under Alternative A. Planting was analyzed in the ESRP.

Cumulative Effects

Approximately 11,140 acres of industrial forest lands burned. Of this, 2,060 acres were disturbed by tractor yarding, 3,255 acres by skyline yarding, and an additional 410 acres by helicopter yarding. This salvage amounts to approximately 21.1 percent of the burn area and 6.7 percent of the watershed.

Fireline construction did not result in detrimental compaction.

Effects of Alternative B on Soil Disturbance

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur and no additional impact to soil compaction on BLM-administered lands would occur.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative B would be the same as effects common to Alternatives B-G, except for the following:

- Thinning without extraction would have no additional adverse effects, because no heavy equipment would be used.
- Since seasonal road closures would not occur, use of non-surfaced roads during winter would continue to disturb soils. Effects would be local in extent and mitigated by riparian vegetation. This would have a moderate long-term adverse impact.

Cumulative Effects

Approximately 11,140 acres of industrial forest lands burned. Of this, 2,060 acres were disturbed by tractor yarding, 3,255 acres by skyline yarding, and 410 acres by helicopter yarding. This salvage amounts to approximately 21.1 percent of the burn area and 6.7 percent of the watershed.

Fireline construction did not result in detrimental compaction.

Effects Common to Alternatives B, C, D, E, F, and G (Preferred Alternative) on Soil Disturbance

Restoration

Direct and Indirect Effects

Culvert replacement would result in a slight short-term increase in soil disturbance. There would be a short-term negative and a long-term beneficial effect as sediment is quickly routed out of the system during periods of high peak flow.

A slight, short-term increase in soil disturbance would occur during installation of fish structures. Driving equipment over vegetation in Riparian Reserves would reduce this impact. No detrimental compaction would result. The degree of impact would be relative to the number of logs, weirs, and gravel deposits emplaced.

Thinning would be conducted under Best Management Practices that minimize soil compaction by logging equipment. Thinning, like any disturbance can have negative effects on soil. However, using proper harvesting techniques and implementing PDFs would minimize logging disturbance.

In areas with live trees, no ripping would take place. Use of designated skid trails would limit impacts to less than 12 percent.

Tractors would commercially thin 62 acres within FMZs. This would result in the compaction and disturbance of a maximum of 12 percent of this area. Underburns would have no effect on compaction.

Thinning and clearing, without extraction, for eagle nesting habitat enhancement would have no effect on compaction. A slight, short-term increase in compaction would occur during placement of log piles for wildlife habitat. No detrimental compaction would result. The degree of impact would be relative to the number of sites.

A slight to moderate increase in soil disturbance during road reconstruction, road maintenance, and stream-crossing upgrades would be local in extent and mitigated by riparian vegetation. This would be a slight, short-term adverse impact.

Decommissioning roads would decrease sediment yields to near natural rates after 10 years. There would be a moderate short-term increase in sediments yielded to local streams during the first few rain events after road work is completed.

Closing and rehabilitating rock quarries and pump chance reconstruction would have minimal soil disturbance in the immediate surrounding area. Effects would be local in extent and mitigated by riparian vegetation. This would have a slight, short-term adverse impact.

Effects Common to Alternatives C, D, E, F, and G (Preferred Alternative) on Soil Disturbance

Salvage

Direct and Indirect Effects

As with any timber harvest activities, soil compaction could increase during fire-salvage operations. For standard logging systems, compaction is primarily limited to skid trails or yarding corridors in cable logging operations. Site-specific conditions and harvest practices would strongly influence the magnitude and duration of compaction effects. Compaction could result in increased storm runoff in localized areas. Because of the potential for increased erosion and runoff in a post-fire environment, compaction effects could be more substantial than in unburned areas.

All tractor yarding would be accomplished using designated skid trails resulting in the compaction of no greater than 12 percent of the unit, as required by the BLM Medford District RMP (USDI 1995, 116). Proposed ripping and water-barring of tractor roads would mitigate this concern. Ripping can be a reasonably effective step in the restoration process (Luce 1996, 10).

Percents in Table 3.3-10 are based on a 1975 study by Klock, which generally involved clearcutting with no predesignated skid trails and no streamside buffers. This represents a worst-case scenario and is presented only as a method to compare alternatives. Predesignated skid trails would be required in any salvage in the Timbered Rock Fire area.

Roadside salvage of between 536 and 1,188 acres in this project would often involve one to five trees per acre, with a corresponding decrease in soil disturbance. Snags felled in Riparian Reserves would be left on-site.

This would cause a slight, short-term adverse effect dispersed over the fire perimeter.

Cumulative Effects

The use of tractors to commercially thin would result in the compaction and disturbance of a maximum of 12 percent of the impacted area.

Fireline construction did not result in detrimental compaction.

Approximately 11,140 acres of industrial forest lands burned. Of this, 2,060 acres were disturbed by tractor yarding,

3,255 acres by skyline yarding, and 410 acres by helicopter yarding. This salvage amounts to approximately 21.1 percent of the burn area and 6.7 percent of the watershed.

Effects of Alternative C on Soil Disturbance

Salvage

Direct and Indirect Effects

Salvage effects under Alternative C would be the same as effects common to Alternatives C-G.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative C would be the same as effects common to Alternatives B-G, except for the following:

- Since seasonal road closures would not occur, use of nonsurfaced roads during the winter would continue to disturb soils. Effects would be local in extent and mitigated by riparian vegetation. This would have a moderate long-term adverse impact.

Cumulative Effects

Cumulative effects under Alternative C would be the same as the cumulative effects of salvage common to Alternatives C-G.

Effects of Alternative D on Soil Disturbance

Salvage

Direct and Indirect Effects

Salvage effects under Alternative D would be the same as effects of salvage common to Alternatives C-G.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative D would be the same as effects of restoration common to Alternatives B-G, except for the following:

- Since seasonal road closures would not occur, use of nonsurfaced roads during the winter would continue to disturb soils. Effects would be local in extent and mitigated by riparian vegetation. This would have a moderate, long-term adverse impact.

Cumulative Effects

Cumulative effects under Alternative D would be the same as cumulative effects of salvage common to Alternatives C-G.

Effects of Alternative E on Soil Disturbance

Salvage

Direct and Indirect Effects

Salvage effects under Alternative E would be the same as effects of salvage common to Alternatives C-G.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative E would be the same as effects of restoration common to Alternatives B-G.

Cumulative Effects

Cumulative effects under Alternative E would be the same as cumulative effects of salvage common to Alternatives C-G.

Effects of Alternative F on Soil Disturbance

Salvage

Direct and Indirect Effects

Salvage effects under Alternative F would be the same as effects of salvage common to Alternatives C-G.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative F would be the same as effects of restoration common to Alternatives B-G, except for the following:

- Since seasonal road closures would not occur, use of nonsurfaced roads during the winter would continue to disturb soils. Effects would be local in extent and mitigated by riparian vegetation. This would have a moderate, long-term adverse impact.

Cumulative Effects

Cumulative effects under Alternative F would be the same as cumulative effects of salvage common to Alternatives C-G.

Effects of Alternative G (Preferred Alternative) on Soil Disturbance

Salvage

Direct and Indirect Effects

Salvage effects under Alternative G would be the same as Effects Common to Alternatives C-G.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative G would be the same as Effects Common to Alternatives B-G.

Cumulative Effects

Cumulative effects under Alternative G would be the same as cumulative effects of salvage common to Alternatives C-G.

3.3.3.6 Soil Productivity

Effects of Alternative A (No Action) on Soil Productivity

Salvage

Direct and Indirect

No salvage would occur in Alternative A, therefore there would be no change in soil productivity.

This alternative proposes no management activities for fire salvage. Post-suppression rehabilitation measures were accomplished before the onset of the rainy season. Recovery would be dependent on fire intensity and duration, area burned, site stability, implementation of the ESRP, and the rate of revegetation.

Restoration

Direct and Indirect Effects

Under Alternative A, no restoration projects are proposed. Planting was analyzed in the Timbered Rock Fire ESRP.

Cumulative Effects

Soil productivity would remain at a low level for several decades, particularly on high burn severity sites, where microinvertebrates and mycorrhizae have been lost. Given time, these species would migrate into these sites from less severely burned areas, and from mycorrhizae inoculated trees planted under the ESRP. Without mycorrhizae to inoculate vegetation, symbiotic interactions between vascular plant species and fungi would not occur, and growth would be curtailed. This would be a slight, long-term adverse effect.

Varied levels of down woody material in associated decay classes are important for soil productivity. In the severely burned areas, decay class 1 and 2 snags became class 3 and 4. Over time, the overabundance of class 3 and 4 coarse woody material on the ground would partially drain nitrogen sources, temporarily decreasing nitrogen availability to growing plants. As wood decays, microbial demand for nitrogen increases. Because of this, nitrogen available to growing plants is diminished during this period. This would be a slight, long-term adverse effect.

Salvage logging on about 6,000 acres of industrial forest lands, combined with whole-tree yarding, would have a long-term negative effect to these lands.

Effects Common to Alternatives B, C, D, E, F, and G (Preferred Alternative) on Soil Productivity

Restoration

Direct and Indirect Effects

The effects of the proposed action would vary on the respective burn severity sites. The proposed action would have a slight-to-moderate beneficial effect as thinning decreases the competition for existing soil nutrients and decreases the fuel loading. The total organic matter removed would have minimal cumulative effects on soil productivity in sites with low and very low burn severity.

A reduction in vegetation density from vegetation treatments would promote the development of late-successional species and structure and could help increase soil organic matter (Amaranthus 1997, 5). Site productivity would also be enhanced by reducing the potential for severe wildfires.

Long periods of protection from fire are associated with fuel buildup (Agee 1993), which leads to litter depths greater than would be expected under a more natural fire regime. Consequently, an uncontrolled natural burn could be of such intensity as to severely increase erosion and sedimentation, and severely impede the community of microorganisms. For this reason, proposed treatments would have a net positive influence on soil resources.

Extraction from thinning in late-successional forest habitat restoration would entail a slight, long-term adverse effect.

Removal during pine restoration would result in a slight, long-term adverse effect.

Commercial thinning of 62 acres during FMZ construction would involve leaving tops and limbs on-site. This would have a slight, long-term adverse effect.

Broadcast and underburns associated with the fuel treatments within owl activity centers would have a moderate effect on the soil. Burning increases the amount of mineral soil exposed by varying amounts, depending on the depth and consumption of the forest floor. Burning can expose up to 40 percent of the burned area. A low intensity burn would have little direct effect on soil properties. A light surface fire would generally char the litter, leaving most of the mineral soil partially covered.

The desired result is a mosaic of burn intensities, where unburned or lightly burned areas may lie adjacent to more severely burned strips. The retention of duff is desired, where duff already exists. The goal is to burn a majority of litter with retention of as much duff as possible. Pockets may exist where a majority of duff is consumed. This is acceptable as long as a mosaic of severity is present. A mosaic would allow migration of soil organisms from adjacent areas to recolonize impacted sites

Piled slash burns hotter than broadcast burning, increasing consumption of organic matter and nutrient losses. High soil temperatures generated under burning piles (typically, about 3-5 percent of the harvested area) negatively affect soil properties by physically changing soil texture and structure,

and reducing nutrient content. Additionally, the intense heat resulting from burning of hand piles would negatively impact soil organisms for the short-term. Migration of soil organisms from adjacent areas would recolonize these sites.

Site productivity would potentially be enhanced by reducing the potential for severe wildfires. An uncontrolled burn could be of such intensity so as to severely increase erosion and sedimentation, and severely delay the community of microorganisms. For this reason, proposed fuel treatments would have a net positive influence on soil resources.

A short-term increase in available nutrients released by burning would benefit newly released vegetation, both tree and browse species.

There would be a short-term increase in available mineral nutrients such as calcium and magnesium. Conversely, there would be a temporary decrease in total site nitrogen, yet available nitrogen would be increased.

Effects of Alternative B on Soil Productivity

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur. Organic matter would not be removed; therefore, there would be no change in soil productivity.

Restoration

Direct and Indirect Effects

Effects from restoration projects proposed under Alternative B would be the same as effects of restoration common to Alternatives B through G.

Cumulative Effects

Soil productivity would remain at a low level for several decades, particularly on high burn severity sites where microinvertebrates and mycorrhizae were lost. Given time, these species would migrate into these sites from less severely burned areas, and from planting of mycorrhizae inoculated trees. Without mycorrhizae to inoculate vegetation, symbiotic interactions between vascular plant species and fungi would not occur, and growth would be curtailed. This would be a slight long-term adverse effect.

Varied levels of down woody material in associated decay classes are important for soil productivity. In the severely burned areas, decay class 1 and 2 snags become class 3 and 4. Over time, the overabundance of class 3 and 4 coarse woody material on the ground would partially drain nitrogen sources and temporarily decrease nitrogen availability to growing plants. As wood decays, microbial demand for nitrogen increases. Because of this, nitrogen available to growing plants is diminished during this period. This would be a slight, long-term adverse effect.

Salvage logging on about 6,000 acres of industrial forest lands, combined with whole-tree yarding, would have a long-term negative affect to these lands.

Effects Common to Alternatives C, D, E, F, and G (Preferred Alternative) on Soil Productivity

Salvage

Direct and Indirect Effects

Table 3.3-12 details the amount of organic material that would be left on-site after the proposed harvest of fire-killed trees in Alternatives C through G.

Cumulative Effects

The proposed action alternatives would remove additional organic matter from the site, but much will remain (see Table 3.3-11). This would not have an immediate effect on existing soil productivity but would negatively impact recovery of soil productivity on moderate and high burn severity sites. The exact amount of impact to soil productivity is unclear but it would take many decades, if not centuries, for the sites with high severity effects to recover to pre-fire soil productivity.

Salvage logging would add an immediate input of tops, limbs, and sawdust to the soil surface. This organic matter would lower sedimentation rates by decreasing the impact and detachment of soil particles by rain. Additionally, it would be a source of organic material available to soil organisms. Salvage logging would also decrease sedimentation and runoff rates by breaking up the hydrophobic soil layers from the impact of falling trees and the disturbance produced by the yarding of this material.

Soil productivity would remain at a low level for several decades particularly on high burn severity sites, where microinvertebrates and mycorrhizae have been reduced. Given time, these species would migrate into these sites from less severely burned areas, and from mycorrhizae inoculated trees planted under the ESRP. Without mycorrhizae to inoculate vegetation, symbiotic interactions between vascular plant species and fungi would not occur, and growth would be curtailed. This would be a slight, long-term adverse effect.

Varied levels of down woody material in associated decay classes are important for soil productivity. In severely burned areas, decay class 1 and 2 snags develop into class 3 and 4. Over time, the overabundance of class 3 and 4 coarse woody material on the ground would temporarily decrease nitrogen availability to growing plants. As wood decays, microbial demand for nitrogen increases. Because of this, little or no nitrogen is available to growing plants during this period. Therefore, salvage of some class 1 snags (recently killed)

would mitigate the future problem of too many class 3 and 4 snags on the ground at the same time. This would be a slight, long-term beneficial effect.

Salvage logging on about 6,000 acres of industrial forest lands, combined with whole-tree yarding, would have a long-term negative effect to these lands.

Effects of Alternative C on Soil Productivity

Salvage

Direct and Indirect Effects

Alternative C would impact productivity by salvaging some of the fire-killed trees on 247 acres. An additional 1,078

Table 3.3-11. Organic Matter Distribution on BLM-administered Lands after Implementation of Alternatives

	Total Organic Matter Remaining by Burn Severity			Fire-killed Trees (>8") Remaining after Salvage
	High	Moderate	Low	
Alternative C (no salvage in low burn severity areas)	• 37% of pre-fire OM • All live trees • All hardwood • Most snags <16" • CWD • 52 snags/acre in WF • 29 snags/acre in DF	• 45% of pre-fire OM • All live trees • All hardwood • Most snags <16" • CWD • 52 snags/acre in WF • 29 snags/acre in DF	• 93% of pre-fire OM	95%
Alternative D (no salvage in low burn severity areas)	• 37% of pre-fire OM • All live trees • All hardwood • Most snags <16" • CWD • 8 snags/acre in DF • 17 snags/acre in WF	• 45% of pre-fire OM • All live trees • All hardwood • Most snags <16" • CWD • 8 snags/acre in DF • 17 snags/acre in WF	• 93% of pre-fire OM	88%
Alternative E	• 37% of pre-fire OM • All live trees • All hardwood • Most snags <16" • CWD • 12 snags/acre in WF • 8 snags/acre in DF	• 45% of pre-fire OM • All live trees • All hardwoods • Most snags <16" • CWD • 12 snags/acre in WF • 8 snags/acre in DF	• 52% of pre-fire OM • All live trees • All hardwoods • All snags <16" • CWD • 4 snags/acre	81%
Alternative F (no salvage in high and moderate burn severity areas)	• 77% of pre-fire OM	• 85% of pre-fire OM	• 38 % of pre-fire OM • All live trees • All hardwood • All snags <16" • CWD • All snags in 2 acres of each unit	96%
Alternative G, Research (no salvage in low burn severity areas)	• 37% of pre-fire OM • All live trees • All hardwood • Most snags <16" • CWD • 6 snags/acre	• 45% of pre-fire OM • All live trees • All hardwood • Most snags <16" • CWD • 6 snags/acre	• 93% of pre-fire OM	87%
Alternative G, Salvage-based (no salvage in low burn severity areas)	• 37% of pre-fire OM • All live trees • All hardwood • Most snags <16" • CWD • 12 snags/acre in WF • 8 snags/acre in DF	• 45% of pre-fire OM • All live trees • All hardwood • Most snags <16" • CWD • 12 snags/acre in WF • 8 snags/acre in DF	• 93% of pre-fire OM	

NOTE: Percents based on 1987 Silver Fire Recovery Plan. All information applies to BLM-administered lands.
OM=Organic Material WF=White Fir DF=Douglas-fir

acres would have roadside hazard trees removed. Table 3.3-11 estimates organic material that would be left on-site in high and moderate burn severity areas. Low burn severity sites would not be entered.

This would result in a slight long-term negative impact to soil productivity that would begin to diminish as vegetation is reestablished.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative C would be the same as Restoration Effects Common to Alternatives B-G.

Cumulative Effects

Alternative C would impact productivity by removing some trees on 2,630 acres. This would affect 3.1 percent of the Elk Creek Watershed and 9.7 percent within the fire perimeter. This would be a slight adverse impact.

Effects of Alternative D on Soil Productivity

Salvage

Direct and Indirect Effects

Alternative D would impact productivity by salvaging some of the fire-killed trees on 820 acres. An additional 1,064 acres would have roadside hazard trees removed. Table 3.3-11 estimates organic material that would be left on-site in high and moderate burn severity areas. Low burn severity sites would not be entered.

This would result in a slight, long-term negative impact to soil productivity that would begin to diminish as vegetation is reestablished.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative D would be the same as restoration effects common to Alternatives B-G.

Cumulative Effects

Alternative D would impact productivity by removing some trees on 3,189 acres, of which 1,064 acres would be roadside hazard tree salvage. This would affect 3.7 percent of the Elk Creek Watershed and 11.8 percent within the fire perimeter. This would be a slight adverse impact.

Effects of Alternative E on Soil Productivity

Salvage

Direct and Indirect Effects

Alternative E would impact productivity by salvaging some of the fire-killed trees on 3,269 acres. An additional 536 acres would have roadside hazard trees removed. Table 3.3-11 estimates organic material that would be left on-site in high and moderate burn severity areas.

This would result in a slight, long-term negative impact to soil productivity that would begin to diminish as vegetation is reestablished.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative E would be the same as Restoration Effects Common to Alternatives B-G.

Cumulative Effects

Alternative E would impact productivity by removing some trees on 6,592 acres, of which 536 acres would be roadside hazard tree salvage. This would affect 7.7 percent of the Elk Creek Watershed and 24.3 percent within the fire perimeter. This would be a slight adverse impact.

Effects of Alternative F on Soil Productivity

Salvage

Direct and Indirect Effects

Alternative F would impact productivity by salvaging some of the fire-killed trees on 213 acres. An additional 1,182 acres would have roadside hazard trees removed. Table 3.3-11 estimates organic material that would be left on-site in low burn severity sites. High and moderate burn severity areas would not be entered.

This would result in a slight, long-term negative impact to soil productivity that would begin to diminish as vegetation is reestablished.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative F would be the same as restoration effects common to Alternatives B-G except late-successional forest habitat, pine restoration, and riparian thinning projects would not occur.

Cumulative Effects

Alternative F would impact productivity by removing some trees on 1,395 acres, of which 1,182 acres would be roadside hazard tree salvage. This would affect 1.6 percent of the Elk Creek Watershed and 5.1 percent within the fire perimeter. This would be a slight adverse impact.

This would result in a slight, long-term negative impact to soil productivity that would begin to diminish as vegetation is reestablished.

Effects of Alternative G (Preferred Alternative) on Soil Productivity

Salvage

Direct and Indirect Effects

The research portion of Alternative G would impact productivity by removing some vegetation on 282 acres. Table 3.3-11 estimates organic material that would be left on-site in high and moderate burn severity areas. Low burn severity sites would not be entered. This would result in a slight, long-term negative impact to soil productivity that would begin to diminish as vegetation is reestablished.

The remaining salvage under Alternative G would impact productivity by salvaging fire-killed trees on 679 acres. An additional 1,188 acres would have roadside hazard trees removed.

Restoration

Direct and Indirect Effects

Restoration effects under Alternative G would be the same as restoration effects common to Alternatives B-G.

Cumulative Effects

Alternative G would impact productivity by removing most fire-killed trees on 282 acres in the research portion and 679 acres in the area salvage. Additionally, 1,188 acres along roads would have hazard trees removed. This would affect 2.5 percent of land within the Elk Creek Watershed and less than 8 percent of land within the fire perimeter. This would be a slight, adverse impact.

3.4 Hydrology

Key points in project area:
- Tier 1 Key Watershed.
- Deferred subwatersheds due to high cumulative effects and for monitoring purposes.
- Increased runoff, erosion, and sedimentation as a result of the fire.
- High road density.
- Major source of sediment is from roads.
- Three streams in the watershed are on the 303(d) list for elevated stream temperatures and one for dissolved oxygen (DO).

3.4.1 Methodology

The BLM Elk Creek Watershed Analysis (USDA and USDI 1996) and the Boise Elk Creek Watershed Analysis (Boise 1999) were the primary sources of information for the pre-fire conditions of the watershed. Field reviews of the area in the fall and winter of 2002-2003 were completed to assess the conditions of the watershed post-fire. GIS data was used for both pre-and post-fire assessment.

GIS data was used to determine road density. New roads built for private access after the fire are not in GIS. Road density was used as a surrogate for sediment sources or watershed condition. However, this includes all roads and does not take into account location or type of road. Roads located next to streams have a higher likelihood of delivering sediment to stream channels than roads located on top of a ridge. In addition, natural surface roads have greater surface erosion than rocked roads and are more likely to deliver sediment to streams.

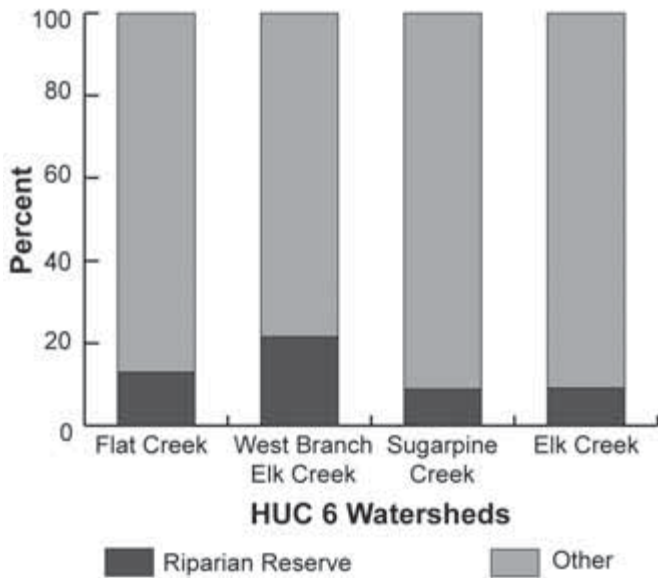
Hydrologic monitoring has begun on BLM-administered lands to determine the effects the fire had on water quality and quantity. Types of monitoring include both continuous and grab samples of water for turbidity, conductivity, and pH. Also being monitored are stream flows. This data will be compared against data collected from Morine Creek which is being used as a control. Other data collection includes photo points and cross sections to determine channel changes, as well as culvert and road inventory to identify problem areas and areas of high risk to water quality.

Four continuous US Geological Survey (USGS) stream gauging stations are located in the Elk Creek Watershed. Three located on Elk Creek are currently in operation while the gauging station on West Branch Elk Creek is presently not in use. Elk Creek below Alco Creek contains a low-flow station only that is used for measuring flows during the summer and early fall months. Other parameters measured by the USGS, besides streamflow, are temperature and turbidity (USDA and USDI 1996, II-10).

BLM Riparian Reserve surveys will be completed on BLM-administered lands within the fire perimeter. Riparian Reserves are modeled from map data and aerial photography interpretation with field verification (see Figure 3.4-1). Streams in the burned area would be surveyed and ground truthed prior to any project implementation. This would help to update the GIS hydrography layer and the extent of Riparian Reserves.

Riparian Reserves are one site potential tree on non fish-bearing streams (160 feet) and two site potential trees (320 feet) on fish-bearing streams in the Elk Creek Watershed. Map 3-6 shows the extent of the Riparian Reserves based on stream surveys inside the fire perimeter. This map also shows where riparian restoration projects for the preferred alternative are located along with the proposed research units that affect Riparian Reserves. This map illustrates the relatively small proportion of reserve area treated for restoration or salvage compared to untreated reserves in the watershed. This map also illustrates the small amount of mainstem or 303(d) listed stream channels managed by

Figure 3.4-1. Percentage of HUC 6 Watersheds in Riparian Reserves



BLM. This is a function of the checkerboard ownership in the watershed.

Other stream surveys completed in the watershed include surveys by USFS, Boise Cascade, and ODFW on fish-bearing streams.

Field surveys determined the average cross-drain spacing is approximately 500 feet. This information was used in the WEPP X-drain model to determine the theoretical delivery of sediment to streams from roads and what the result would be by decreasing the cross-drain spacing. WEPP output gives cross-drain spacings of 30, 100, 200, 400, and 800 feet. For this analysis, the difference between 400 and 200 feet was used instead of the existing average of 500 feet .

3.4.2 Affected Environment

The Elk Creek Watershed encompasses an 85,362 acre area. Elk Creek, a tributary to the Rogue River, is classified as a sixth order basin (Boise 1999, 3). Tributaries to Elk Creek range from 1st to 5th order or higher in size. Stream order is the designation of the relative position of stream segments within a drainage basin or watershed.

Five subwatersheds have been delineated within this watershed. These subwatersheds are West Branch Elk Creek, Flat Creek, Sugarpine Creek, Bitter Lick Creek, and Button Creek. These are considered 6th field subwatersheds and Elk Creek is a 5th field watershed within the 4th field Rogue Basin.

Elk Creek is designated in the Medford District RMP as a Tier 1 Key Watershed. Tier 1 Key Watersheds were selected for directly contributing to anadromous salmonid and resident fish species conservation (USDI 1995, 22-23).

In the Medford District RMP, 7,611 acres of BLM-administered lands in the Elk Creek Watershed were deferred from management activities due to high watershed cumulative effects (see Map 3-7). The deferment was based on high amounts of equivalent clearcut acres (ECA), compacted acres, openings in the transient snow zone (TSZ), and road density. These indicators were used to determine the condition of the watershed due to land management activities. For a more detailed discussion, see pages 42 and 43 in the Medford District RMP.

The Upper Morine Creek Watershed is designated by the Medford District RMP as a watershed monitoring area and is deferred from timber harvest and other management activities. Upper Morine Creek has been paired with Hungry Creek as a like watershed where management activities could occur. The comparison of these two like watersheds is useful to provide baseline information of the effects of management activities on water quality and quantity.

Some proposed fuel treatments lie on the ridge outside of the Elk Creek 5th field watershed. These proposed units are within the Trail Creek and Lost Creek watersheds. These watersheds have very similar hydrology and past land management practices as Elk Creek and, therefore, the affected environment is very similar.

Beneficial uses identified by ODEQ under OAR 340-041-0362 for streams in the Elk Creek Watershed are public and private domestic water supply, irrigation, industrial water supply, livestock watering, anadromous fish passage, salmon and trout rearing, salmon and trout spawning, resident fish and aquatic life, fishing, wildlife, water contact recreation, and hydro power.

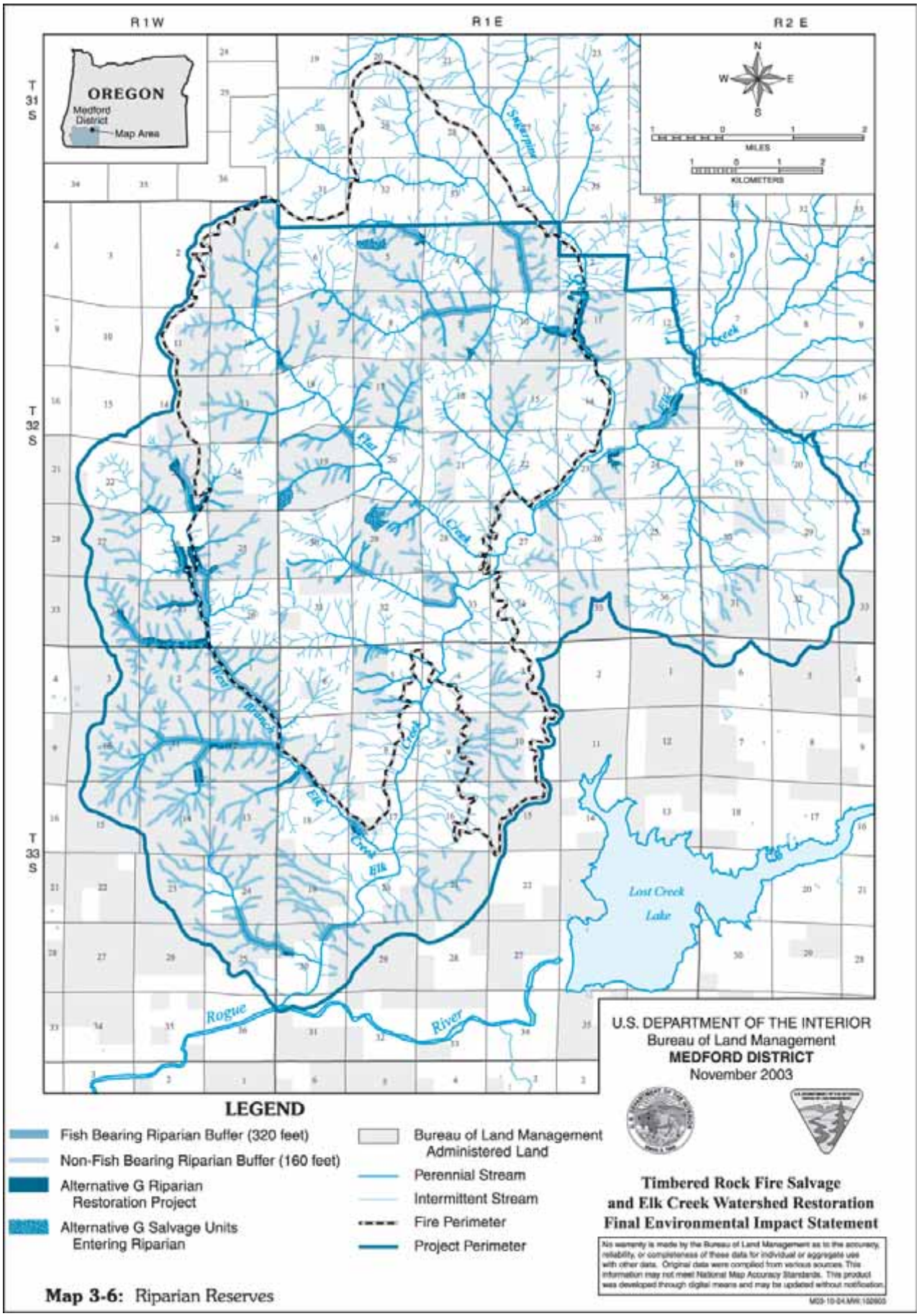
3.4.2.1 Water Quality

Pre-fire

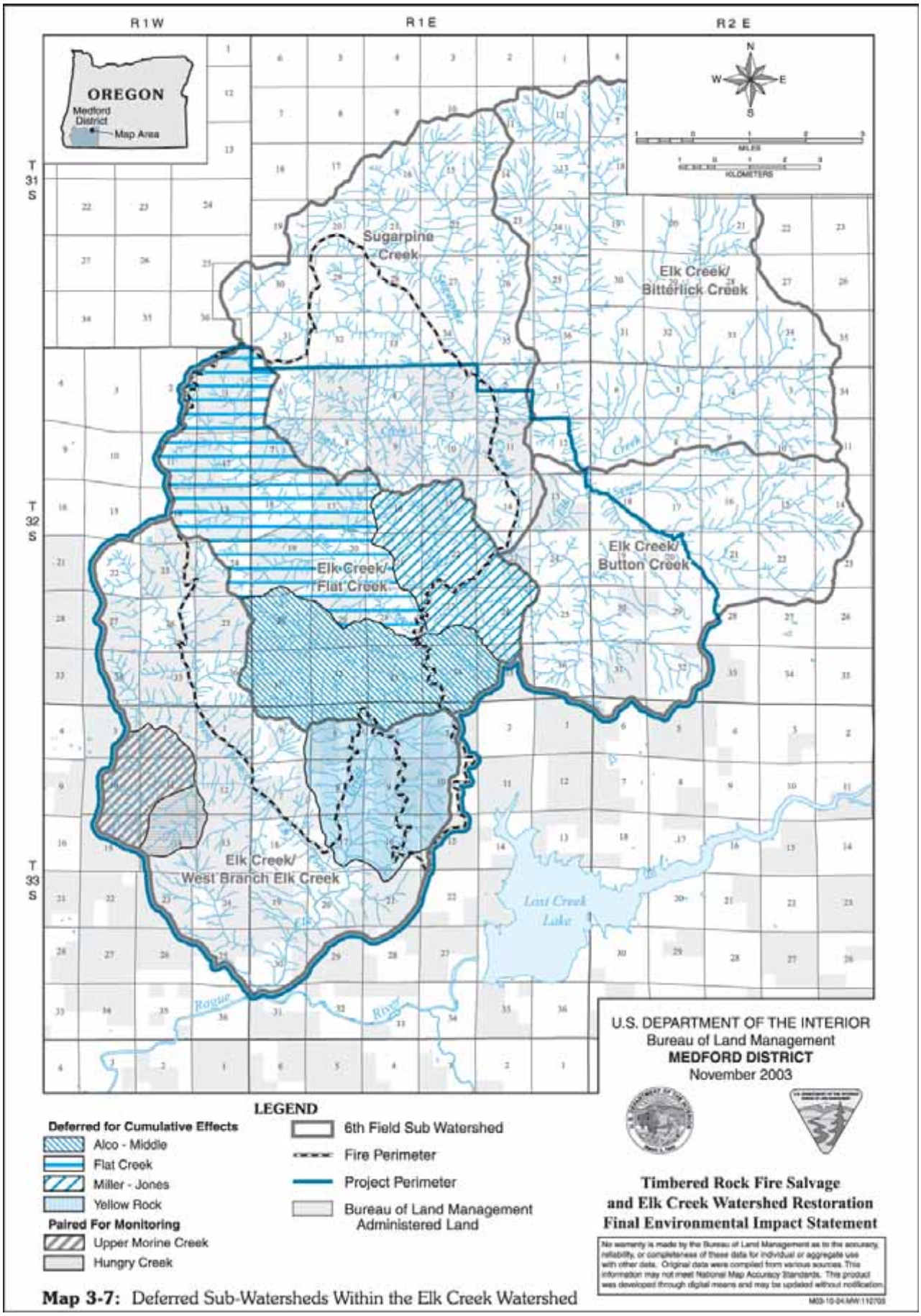
"Water quality in the Elk Creek Watershed varies spatially and temporally. During the winter months, streams are generally of good quality. Increased levels of turbidity and stream flow are common in response to storm events, but are usually of short duration and are part of the natural function of the watershed. During the summer, stream temperatures increase to detrimental levels in a number of streams." (USDA and USDI 1996, II-18).

Sediment

"Sediment input from background (natural) sources in the Elk Creek Watershed is estimated to be 3,300 tons per year. One-third of the background sediment is supplied from mass wasting along stream banks and in forested areas" (Boise 1999, 13).



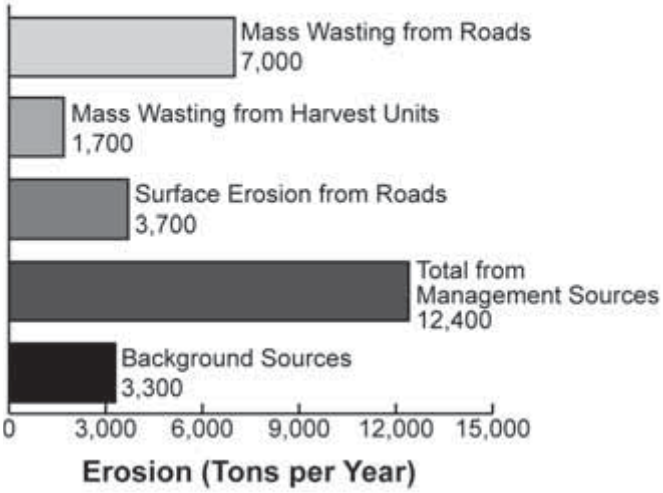
Map 3-6: Riparian Reserves



Map 3-7: Deferred Sub-Watersheds Within the Elk Creek Watershed

Figure 3.4-2 shows the sources of sediment in the Elk Creek Watershed and the differences of erosion between management sources and background levels. When compared to the 3,300 tons/year from background sources, management activities in the basin add almost four times the amount of sediment as background sources. "This added sediment can have noticeable effects on water quality, stream channel, and fisheries resources." (Boise 1999, 14). Stream-crossings and roads that parallel streams are the areas with the greatest probability of delivering fine sediment to streams.

Figure 3.4-2. Sediment Sources in the Elk Creek Watershed



In general, there is a lack of coarse sediment and an abundance of fine sediment in this watershed. Coarse sediment (gravel, cobble, boulder) is important for channel complexity and fish habitat. Fine sediment (sand, silt, clay) can contribute to aggradation of stream channels and fill in the spaces between gravels.

Road density in the Elk Creek Watershed is 4.66 miles per square mile. Approximately 39 percent of the roads are located inside Riparian Reserves. Of those, approximately 13.5 percent are within the Riparian Reserves of fish-bearing streams.

Elk Creek is classified as a Tier 1 Key Watershed in the Medford District RMP. One of the goals in key watersheds is to reduce existing system and nonsystem road mileage. There is to be no net increase in the amounts of roads in key watersheds.

Temperature

Three streams in the Elk Creek Watershed fail to meet the Oregon Department of Environmental Quality (ODEQ) summer standard for stream temperature. These streams are classified as water quality limited under the Clean Water Act (CWA) and are on the 303(d) list.

In 2002, the following streams in the Elk Creek Watershed were listed on the 303(d) list as water quality limited for summer stream temperature:

- Bitter Lick from river mile 0.0 to 8.6.
- Elk Creek from river mile 0.0 to 13.3.
- West Branch Elk Creek from river mile 0.0 to 7.4.

The 2002, 303(d) list also includes Elk Creek for Dissolved Oxygen (DO) from river mile 9.5 to 20.7 from June 1 to September 30.

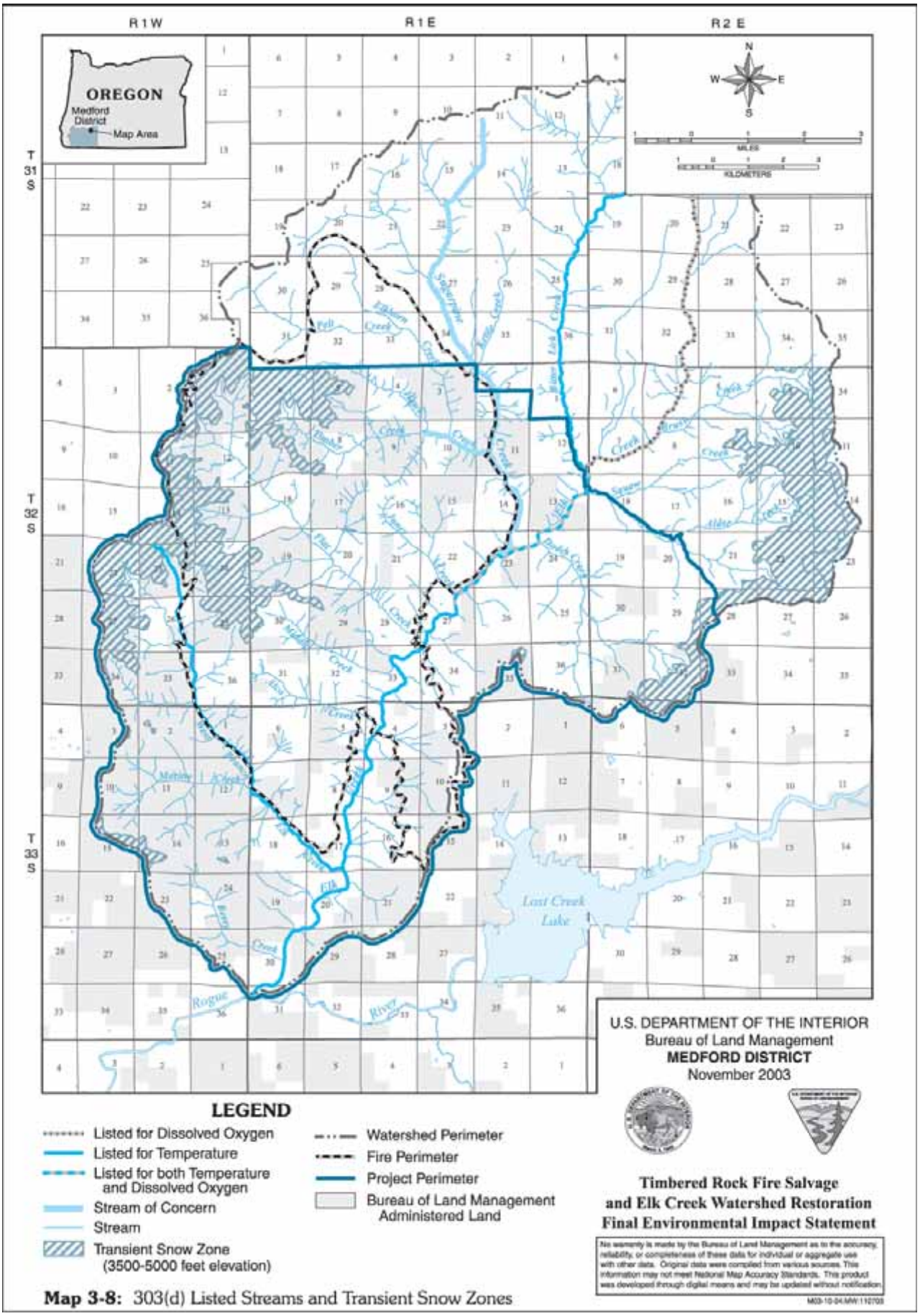
Sugarpine and Hawk creeks were removed from the final 2002, 303(d) list but they remain a potential concern for temperature. These streams were removed from the 303(d) list because they were originally listed with data collected during a drought year making the listing invalid. The following map shows the extent of streams on the 2002, 303(d) list and the parameter they are listed for (see Map 3-8).

Monitoring indicates many streams in the watershed may naturally exceed the ODEQ 64 degree standard for maximum summer stream temperature (Boise 1999, D-25). Temperatures are elevated in Elk Creek Watershed due to the past removal of streamside vegetation during agricultural or logging operations. Other causes of increased stream temperature in the watershed include simplification of streams channels, channel straightening, and irrigation withdrawals (USDA and USDI 1996, II-18).

Pre-fire temperature data on both public and private lands will be used to monitor effects from the fire on stream temperatures. This data is from streams both inside and outside the fire perimeter (see Appendix I).

The *US Forest Service and Bureau of Land Management Protocol for Addressing Clean Water Act Section 303(d) Listed Waters* is the means for developing a comprehensive restoration and water quality management strategy and the means for upholding the BLM's responsibilities as the Designated Management Agency (DMA) under the Clean Water Act (CWA). A Water Quality Restoration Plan (WQRP) has been developed for the Elk Creek Watershed and is included in Appendix I.

The State of Oregon *Antidegradation Policy for Surface Waters* (OAR 340-041-0026) sets policies and guidelines generally applicable to all basins guiding "decisions that affect water quality such that unnecessary degradation from point and nonpoint sources of pollution is prevented, and to protect all existing beneficial uses. The standards and policies set forth in OAR 340-041-0120 through 340-041-0962 are intended to implement the Antidegradation Policy." (ODEQ Oregon Administrative Rules, Division 41).



Map 3-8: 303(d) Listed Streams and Transient Snow Zones

Channel Morphology

Stream surveys found channels are lacking large woody debris. The surveys also determined channels scoured to bedrock were common. "Spawning gravel was also lacking, both in volume and appropriate size and pool frequency was low" (Boise 1999, 12).

Roads tend to parallel the major tributaries to Elk Creek, causing the stream channels to be confined. The location of these roads also limits the amount of riparian vegetation necessary to maintain high water quality.

In general, the streams in the Elk Creek Watershed are Rosgen types "A" and "B" with some reaches of "C" stream types lower in the watershed. Stream types "A" are steep to very steep, well entrenched, and totally confined with a low width/depth ratio. These streams are referred to as step/pool morphology and associated with debris flows and waterfalls. The "B" stream types are moderately entrenched, have low channel sinuosity, and characteristic "rapids". The "C" channel types have a well developed floodplain (slightly entrenched) and are relatively sinuous with a channel slope of 2 percent or less. These streams are typically riffle/pool morphology (Rosgen 1996, 4-4 and 4-6).

Large Woody Debris

"At the present time, there is a chronic lack of large woody debris (LWD) in all channels and the lack of woody structure to retain sediment has resulted in the scouring of channels to bedrock." (Boise 1999, iv). This is common throughout the watershed on both public and private lands.

Post-fire

The Timbered Rock Fire burned in 2, 5th field watersheds; 4, 6th field subwatersheds; and 25, 7th field drainages. The burn severity varied from very low/unburned to high across these three different scales (see Table 3.4-1).

The Timbered Rock Fire burned through approximately 80 percent of the deferred watersheds. The fire did not burn through the paired watersheds of Morine and Hungry creeks. These paired watersheds can provide baseline data which can be used to compare the effects of the fire.

Main stems of streams in the high and moderate burn severities tend to be on private lands.

Sediment

Activities related to fires and fire management such as construction of fireline, temporary roads, and heli-pads, and post-fire rehabilitation can have affects on erosion (Robichaud, Beyers, and Neary 2000, 8). The majority of these activities increase erosion while post-fire rehabilitation minimizes erosion, especially from these activities.

Approximately 22.6 miles of tractor fireline and 9.8 miles of handline were created during the fire suppression efforts. These firelines were rehabilitated by water-barring, pulling organic debris back on the surface, and blocking. An additional 30.8 miles of existing road were used as fireline.

Riparian Reserves act as a buffer to stream channels to maintain high quality water. During the fire, many of the buffers burned to some degree. The buffers with high and moderate burn severities are less effective than if they were fully intact and functional because much of the duff and litter layer was consumed and no longer functions to trap sediment and store moisture. These buffers would become more effective as vegetation reestablishes and the duff and litter layer redevelops as vegetation dies and decays. The short-term (1-3 years) recovery of vegetation would begin to filter out sediment while the duff layer recovers in the long-term (3-10 years).

Post-fire sediment levels are expected to increase by many orders of magnitude. Increased levels of sediment after fires are common due to the loss of vegetation and the litter layer. Fall and winter rains the first year after a wildfire is when the largest increase in sediment transport occurs. Erosion and subsequent sedimentation is reduced each consecutive year

Table 3.4-1. Burn Severity by Watershed (BLM)

Watershed	High	Moderate	Low	Very Low/ Unburned	Outside Fire Perimeter
Sugarpine Creek 6th field	2.8%	12.8%	17.5%	22.8%	44.1%
Flat Creek 6th field	12.1%	27.1%	25.0%	20.6%	15.3%
West Branch Elk Creek 6th field	3.5%	12.0%	14.4%	10.1%	60.1%
Rogue River/Lost Creek 5th field	--	4.2%	2.4%	2.7%	90.7%
Elk Creek 5th field	3.3%	9.1%	9.9%	9.2%	68.5%
Timbered Rock Fire	10.3%	29.0%	31.3%	29.3%	--

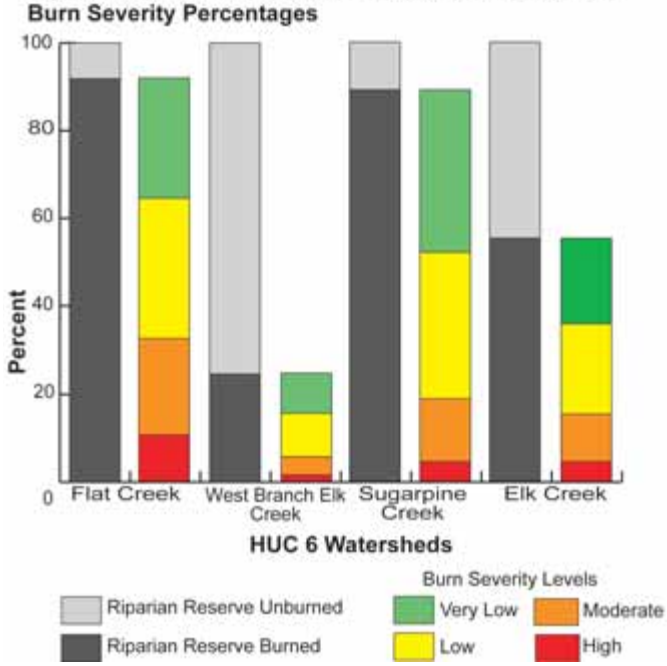
until reaching pre-fire levels, after the recovery of vegetation. The Elk Creek Watershed has gone through one relatively mild winter since the fire and is now recovering naturally and through erosion control projects like grass seeding and mulching (through the ESRP). This recovery process is expected to reduce levels of erosion and sedimentation below those of 2003 and levels should continue to reduce through each year of recovery.

Post-fire road density has increased but it is not known by how much. Roads previously blocked, closed, or overgrown were opened to provide access for the fire. About seven miles of new roads on industrial forest lands were created or will be created post-fire to provide access for salvage logging. Logging traffic from private timberlands has increased since the fire, causing more sediment to become mobile, especially during wet weather.

Temperature

Post-fire stream temperatures are expected to increase due to the loss of riparian vegetation. The amount of increase depends on site-specific variables such as aspect, side slopes, remaining canopy, size of stream, and source of flows. As vegetation recovers and stream canopy closes, stream temperatures would be expected to return to pre-fire levels. High and moderate burn severities have removed streamside canopies on approximately 10 miles of perennial and fish-bearing streams on public and private lands, with the greatest amount in the Flat Creek subwatershed (see Figure 3.4-3).

Figure 3.4-3. Percent of Riparian Reserves Burned and Burn Severity Percentages



Riparian Reserves with a moderate to high burn severity are no longer fully functional due to consumption of canopies by the fire. Although standing snags provide some shade, these buffers may not be sufficient to maintain current stream temperatures. The recovery of streamside vegetation and canopy would return the stream temperatures to those before the fire. This long-term recovery would take approximately 15-20 years.

Channel Morphology

"A stable stream channel reflects the dynamic equilibrium between incoming and outgoing sediment and streamflow." (Rosgen 1996). "Increased erosion after fires can alter this equilibrium by transporting additional sediment into channels (aggradation). However, increased peak flows that result from the fires can also produce channel erosion (degradation)." (Robichaud, Beyers, and Neary 2000, 9).

An increase in stream flows due to higher runoff from the fire has raised the amount of channel erosion and channel downcutting. Channel erosion and downcutting was observed in winter 2003 during field reviews and is evident from photo-points established for monitoring.

Cattle grazing in the watershed on private and public lands will be temporarily suspended for a period of two years to allow the vegetation to recover after the fire. Suspending grazing will keep cattle from trampling streambanks so rapid vegetation recovery would occur.

Streams within the burn area were surveyed in the summer of 2003 to determine the extent of Riparian Reserves, as well as to determine the functioning condition of streams. Functioning condition is a measure of physical and biological parameters of a stream channel and riparian area. This assessment determines the stream's ability to withstand high flows and provide high quality water and associated habitat for riparian dependent species. Table 3.4-2 contains a summary of the results of the stream surveys by 6th field watershed completed within the Timbered Rock Fire area. For a breakdown of stream surveys by sections within the 6th field watersheds for the Timbered Rock Fires area, see Appendix I, Hydrology.

Approximately two-thirds of streams in these three subwatersheds are currently functioning at-risk with one-third properly functioning. Flat Creek is the subwatershed with the highest amount of streams on a downward trend or non-functional. Streams in this subwatershed are at the greatest risk for channel erosion due to increased runoff, especially during high flow events. Streams in these conditions will continue to degrade and will take much longer to recover than those that are functioning at-risk with an upward trend or streams that are properly functioning.

Large Woody Debris (LWD)

LWD is an important component of a functioning watershed benefiting riparian dependent species, upland species, riparian habitat, and stream channel condition.

Table 3.4-2. Functioning Condition of 6th Field Watersheds within the Timbered Rock Fire

	Proper Functioning Condition		Functioning At-Risk with an Upward Trend		Functioning At-Risk with No Apparent Trend		Functioning At-Risk with a Downward Trend		Non-Functional		Total	
	miles	%	miles	%	miles	%	miles	%	miles	%	miles	%
Elk-Flat	10.27	31.6	9.98	30.7	8.19	25.2	3.41	10.5	0.66	2.0	32.51	56.2
Sugarpine	5.69	31.6	9.12	50.7	2.84	15.8	0.29	1.6	0.06	0.3	18.0	31.1
West Branch Elk	2.37	32.3	2.43	33.1	2.23	30.4	0.31	4.2	0.0	0	7.34	12.7
Total	18.33	31.7	21.53	37.2	13.26	22.9	4.01	6.9	.72	1.3	57.85	100

Much of the LWD in areas of moderate to high burn severity was consumed or partially consumed during the fire, decreasing the amount of LWD. The remaining LWD has a greater potential to be removed from the system, especially with the expected increases in stream flows.

However, the short-term recruitment of LWD in stream channels has increased, due to the dramatic increase in dead riparian trees. Long-term LWD recruitment may be limited for many decades until new trees can reach maturity. The size of LWD required to be effective is dependent on stream power. Several log structures placed and cabled in Flat Creek after the fire on private timberlands have moved locally or shifted slightly since winter storms.

3.4.2.2 Water Quantity

Pre-fire

Average annual precipitation varies by location within the watershed. Expected annual precipitation in the watershed ranges from less than 35 inches to more than 60 inches. On average, the Elk Creek Watershed receives about 44 inches of precipitation each year. The streamflow regime is similar to the precipitation pattern. However, runoff generally lags behind precipitation by about a month.

Historic extreme high flows have been produced by rain-on-snow (ROS) events where warm rains have melted the snowpack, producing large amounts of runoff. The Transient Snow Zone (TSZ) is an elevation band ranging from 3,500-5,000' where snow accumulates and is susceptible to ROS events (see Map 3-8). The range of variability in flows is very large in this watershed. The largest peak flow of record at Elk Creek near Trail occurred in December 1964 at a flow rate of 19,200 cubic feet per second (cfs). Later that year, the discharge dropped to 0.40 cfs. The lowest mean daily flow of record occurred in September 1994 when the discharge was 0.12 cfs. The average flow for this site is 216 cfs (USDA and USDI 1996, II-10).

Stream Flow

In general, predicted changes in peak flows are small in the basin from historic to current conditions because estimated crown closure density is greater today. “This can also be attributed to the fact that not much snow accumulates on the ground in the majority of the watershed.” (Boise 1999, C-45).

Although changes in peak flows are small when comparing historic to current conditions, there are relative differences between subwatersheds. The subwatersheds peak flows determined to be the most responsive to changes in canopy cover are mostly located outside the Timbered Rock Fire perimeter. “Bitter Lick Creek subbasin has the highest potential for increases in peak flows since the area has not been harvested and fire suppression has increased stand densities” (Boise 1999, C-38).

Channel Extension

The stream channel network can be extended due to increased runoff from roads and other disturbances. Road ditches can extend the stream network, increasing runoff during the early part of the storm. The excess runoff from roads can overload ephemeral channels, resulting in substantial downcutting of the channel (Dissmeyer 2000, 86-87).

Where surface flows are continuous between roads and streams, such as where ditches convey road runoff to stream channels, the road generating or receiving the runoff is considered to be “hydrologically connected” to the stream network. In other words, a hydrologically-connected road becomes part of the stream network (Furniss, Flanagan, and McFadin 2000, 1).

“A study conducted in the Western Cascades of Oregon (Wemple, et al. 1996) detailed the mechanisms whereby inboard ditches on roads extend the stream network, change runoff timing, and increase peak flows. They found that 57 percent of roads segments studied were linked to surface flow paths. Primary linkages were ditches draining to road-stream-crossings and ditches draining to gullies below cross drains” (Furniss, Flanagan, and McFadin 2000, 1).

Post-fire

Stream Flow

Soils, vegetation, and litter are critical to the functioning of hydrologic process (Robichaud, Beyers, and Neary 2000, 5). The Timbered Rock fire increased open areas considerably by removing overstory canopy, and consuming litter, duff, and woody debris. When a precipitation event follows a large, moderate to high burn severity fire, it results in increased runoff, peak flows, and sediment delivery to streams that can affect fish populations and their habitat (Robichaud, Beyers, and Neary 2000, 6).

"With good hydrologic condition (greater than 75 percent of the ground covered with vegetation and litter), only about 2 percent or less of rainfall becomes surface runoff, and erosion is low (Bailey and Copeland 1961). When site disturbances, such as severe fire, produce hydrologic conditions that are poor (less than 10 percent of the ground surface covered with plants and litter), surface runoff can increase by over 70 percent and erosion can increase by three orders of magnitude." (Robichaud, Beyers, and Neary 2000, 5).

The Timbered Rock Fire burned about 44 percent of the Flat Creek 7th field drainage at high and moderate severity levels. The Middle Creek 7th field drainage has a moderate to high burn severity over 76 percent of its area leaving only about 7 percent of this drainage unburned. This put the stream channels in these drainages at a high risk for increased runoff, debris flows, and channel erosion.

Water repellent soils and cover loss would cause flood peaks to arrive faster, rise to higher levels, and transport considerably greater amounts of bedload and suspended sediments (Robichaud, Beyers, and Neary 2000, 8). Water repellent soils are formed after fires where high temperatures persisted for long periods and created conditions that prevent infiltration and percolation of water into the soil mantle. The extent of water repellent soils after the fire is not known. Typically, the extent is spotty and in general tends to break up after the first major rain.

Channel Extension

Due to increased runoff caused by the fire, the extent of hydrologically-connected roads would likely also increase. This would further extend the stream network and increase the amount of road-derived sediment delivered to streams beyond the pre-fire conditions.

Road number 32-1-33.3 does not have cross-drains between stream-crossings. The ditch in this situation is extending the channel network. Adding cross-drains between the road stream-crossings would reduce the amount of hydrologically-connected road.

In T32S, R1E, Section 19, water concentrated on the upper road and drained into the uplands. This caused saturated conditions and subsequently a debris torrent occurred. The debris torrent scoured the stream channel to bedrock and spilled across the lower road.

3.4.3 Environmental Consequences

Responses of watersheds to disturbances are very complex and depend on a great deal of conditions that include, but are not limited to, the timing and intensity of storm events, slope, aspect, soils, channel stability, ground cover, and canopy cover. All of these conditions vary greatly over time and space to produce different watershed responses. The magnitude of effects from management activities depends largely on the timing and intensity of storm events during the recovery process. Water quality discussions include sediment, temperature, channel morphology, and large woody debris.

The Antidegradation Policy standards and policies begin in *OAR 340-041-0120 Implementation Program Applicable to All Basins*. Section (11)(e)(A) of these rules state "Federal forest management agencies are required by the federal Clean Water Act to meet or exceed the substantive requirements of the state forestry nonpoint source program." The ODEQ currently has MOUs with the US Forest Service and BLM to implement this aspect of the Clean Water Act. These memoranda will be used to identify the temperature management plan requirements for federal forest lands;

The use of appropriate BMPs, the development of a Water Quality Restoration Plan (WQRP) for the Elk Creek Watershed (see Appendix I), and continued water quality monitoring in the watershed are methods to meet the requirements of the Antidegradation Policy of the Clean Water Act. These are applicable to all alternatives and therefore all alternatives are meeting the Antidegradation Policy. As of August 26, 2003, the BLM and the Oregon Department of Environmental Quality have signed a Final Water Quality Memorandum of Agreement (MOA) that updates the 1990 agreement and defines the process by which ODEQ and the BLM will cooperatively meet State and Federal water quality rules and regulations.

ACS Consistency Common to all Alternatives

The components of the Aquatic Conservation Strategy are Riparian Reserves, Key Watersheds, watershed analysis, and watershed restoration. A full list of management actions/direction for meeting ACS objectives under these components is listed in the Medford District RMP.

With the exception of entering approximately 11 acres of Riparian Reserves on intermittent streams for research purposes, this project would maintain full Riparian Reserves to meet ACS objectives. At a watershed and subwatershed scale this would still be considered meeting ACS objectives.

Elk Creek is a Tier 1 Key Watershed which contributes directly to conservation of at-risk anadromous salmonids and resident fish species. Key Watersheds also have a high potential of being restored as part of a watershed restoration program.

A watershed analysis, another component of the ACS, was completed on Elk Creek in 1996.

Watershed restoration projects proposed in this EIS make up the final component of the ACS. Some actions proposed in this EIS to meet ACS objectives in the Elk Creek Watershed include reducing existing system and nonsystem road mileage (there should be no net increase in the amount of roads in Key Watersheds) and giving highest priority to Key Watersheds for watershed restoration.

The most important components of a watershed restoration program are control and prevention of road-related runoff and sediment production, restoration of the condition of riparian vegetation, and restoration of in-stream habitat complexity. All of these components are included in projects proposed under this EIS therefore meeting ACS objectives. The ACS objectives help to attain state water quality standards.

3.4.3.1 Water Quality

Effects of Alternative A (No Action) on Sediment

Salvage

Direct and Indirect Effects

Under the No Action Alternative, fire-killed trees would not be salvaged. No temporary roads or landings would be built. There would be no additional ground disturbance related to salvage under this alternative. Alternative A would not contribute to additional road density within the Elk Creek Watershed. Salvage would not contribute additional sediment to streams.

Restoration

Direct and Indirect Effects

Under the No Action Alternative, no restoration projects would be implemented. There would be no additional ground disturbance related to restoration under this alternative. No roads would be improved, decommissioned, or closed. Alternative A would not contribute to or reduce road densities in the Elk Creek Watershed. The current watershed condition related to sediment would be maintained. This alternative would not contribute additional sediment or reduce the amount of sediment currently being delivered to stream channels.

Projects identified in the Emergency Stabilization/ Rehabilitation Plan (ESRP 2002) would be implemented. Projects completed after the fire include installing check dams, in-stream wood placement, seeding with native and nonnative grasses, and mulching. Other projects identified in the ESRP that would be implemented include culvert upgrades, riparian and upland planting, road maintenance, and/or road weatherization. These projects would help reduce erosion and the risk of road and culvert failure, thereby reducing sediment delivery.

Cumulative Effects

A total of 10,660 acres burned at moderate to high severity. These levels of burn severity removed all or most of the litter layer. With the litter layer removed, runoff and erosion would increase on these acres during storm events. The greatest number of acres burned at high and moderate severities occurred in second growth vegetation where mature stands and old-growth were more resilient to fire. The greatest concern with respect to sedimentation would be high and moderate burn severity areas located in Riparian Reserves due to connectivity to stream channels. Another area that could potentially deliver sediment would be roads in moderate to high burn severity areas hydrologically-connected to streams, i.e. a ditch that drains directly into a stream. This connectivity is high in this watershed due to lack of sufficient road maintenance and insufficient drainage structures.

Approximately 22.6 miles of tractor fireline and 9.8 miles of handline were built during fire suppression efforts. An additional 30.8 miles of existing road was used as fireline. These suppression activities increased the amount of erosion and subsequent sedimentation. However, tractor and hand firelines have been rehabilitated and sediment production from these sources would be eliminated after recovery, approximately 2-3 years.

On BLM-administered lands, firelines were water-barred; berms were pulled back; organic matter, such as downed wood and shrubs, were pulled onto the firelines; riparian areas were grass-seeded and mulched; firelines outside riparian areas were seeded; and firelines were blocked at property boundaries to prevent vehicle access. Similar activities were completed on US Forest Service and USACE administered lands. Firelines on private lands were water-barred. These activities aid in reducing the amount of erodible sediment by keeping water from channeling on the firelines, reducing the amount of raindrop impact, covering and revegetating exposed soil, and reducing further motorized vehicle access.

Past actions, including road building and logging, have also added to sedimentation. The main roads in the watershed tend to be within the Riparian Reserves parallel to perennial streams. The roads lower in the watershed are paved. Roads higher in the watershed are rocked or natural surface. The potential for sediment delivery from roads paralleling streams would be greatest where cross drain spacing is insufficient and road drainage or surfacing is in poor

condition. Roads in this situation would deliver chronic fine sediment over many years or decades, contributing to poor aquatic habitat. This situation is common in the watershed.

Mid-slope roads cross intermittent and perennial streams rather than parallel them. The intersection between the road and stream is the location where the greatest amount of fine sediment would be delivered. This crossing also has the greatest potential for failure during storm events which could deliver large amounts of fine sediment at one time. This episodic event differs from natural episodic events such as debris torrents. The debris consists of finer particle fill rather than a mixture of different sized material ranging from silt to boulders, including large wood. Fill failure has a negative effect on water quality and aquatic habitat due to fine grain sediment delivery, whereas debris torrents are beneficial to a functioning watershed.

Salvage logging on industrial forest lands began in 2002 and will continue, with approximately 6,000 acres harvested by 2004. These acres will be salvaged using cable, tractor, and helicopter logging methods. The amount of disturbance, erosion, and subsequent sedimentation depends on the logging method used. The type of stream buffered and size of stream buffering is different on private lands than public lands, and has the potential to allow more sediment to reach stream channels

Sediment would also be delivered to streams from salvage logging through hauling on natural surfaced roads, especially during wet weather. Private timber companies hauled salvaged logs through much of the winter, causing roads to become rutted and providing mechanisms for fine sediment delivery. The *Sufficiency Analysis: A Statewide Evaluation of Forest Practices Act Effectiveness in Protection Water Quality* determined that "with the exception of wet-weather road use, complying with the road construction and maintenance rules currently in place is likely to result in meeting water quality standards." (ODF and ODEQ 2002, 6).

The combined effects of past, present, and future activities within the fire perimeter have resulted in high cumulative watershed effects. Some drainages within the fire perimeter are at a high risk for increased sediment input as well as changes in flows. These effects would be less at a 6th field subwatershed and 5th field watershed scale.

During field reviews, many pools in streams were observed to contain fine sediment. The majority of the sediment most likely came from roads and accumulated in the streams. This would have a negative effect on water quality.

The cumulative effects resulting from the fire and suppression activities related to road density come from opening up closed or overgrown roads. Before the fire, these roads had little to no traffic because they were blocked or overgrown. Opening these roads up for fire access allowed traffic to use these roads causing more fine sediment to become mobile. Roads previously overgrown and vegetated were brushed and bladed to provide access. Vegetation providing erosion protection was removed from the road surface.

Road density is one indicator used to determine watershed cumulative effects. Road density in the watershed is considered high at 4.7 miles per square mile. The recommended road density in the Elk Creek WA is 2.5 miles/square mile. Approximately 630 miles of active roads and an unknown number of jeep trails are located in the watershed. Roads on public lands, including roads that may be considered jeep roads, have been field reviewed and evaluated. Since the fire, private timber companies have constructed approximately four miles of new road inside the fire perimeter. An additional three miles of new road within the fire perimeter is estimated to be constructed by private timber companies in 2003. The addition of seven miles of new road would slightly add to the road density in the subwatersheds located inside the fire perimeter.

High road density can have many negative effects on streams and aquatic habitat, especially when roads are hydrologically-connected and adjacent to streams. High road density increases the amount of fine sediment delivered to stream channels as do natural surface roads. The probability of road failure also increases with high road densities.

The effects of the fire would increase the sediment yield the greatest in the short-term (1-3 years) by increasing both runoff and erosion. These effects would diminish as vegetation recovers in the first few years after the fire. Roads would still remain a chronic source of sediment after the effects of the fire diminish.

Effects of Alternative B on Sediment

Salvage

Direct and Indirect Effects

Under Alternative B, fire-killed trees would not be salvaged. No temporary roads or landings would be built. There would be no additional ground disturbance related to salvage under this alternative. Alternative B would not contribute to additional road density within the Elk Creek Watershed. Salvage would not contribute additional sediment to streams.

Restoration

Direct and Indirect Effects

Alternative B would implement a focused level of restoration projects. Changes in sediment levels could come from roadwork and fish habitat improvement projects. Restoration would focus on high priority road work within the fire perimeter and LSR restoration actions would focus on non-commercial treatments.

Projects with the greatest potential to affect sediment levels would primarily come from activities associated with roads. These projects include road improvements, renovation, full or partial decommissioning, closures, and stream-crossing upgrades. In the short-term (1-3 years), there would be an increase in sediment from these projects due to disturbing soil that was previously stabilized. As vegetation recovers, these effects would diminish and become negligible.

In the long-term (greater than 3 years), these projects would decrease the amount of sediment delivered to streams by decreasing cross-drain spacing, adding rock to roads, closing or decommissioning roads, and decreasing the likelihood of culvert failure through culvert upgrades. These projects would reduce the chronic delivery of fine sediment to streams and, therefore, improve aquatic habitat over time.

Road density would be reduced in the watershed by fully decommissioning 33 miles of road and partially decommissioning 2.5 miles of road. An additional 21 miles would be temporarily closed using gates or an earthen berm. This would reduce the amount of active roads in the watershed, thereby reducing sediment delivery.

Based on application of the WEPP X-drain model, estimates of sediment reduction percentages are used in this analysis. Absolute values of sediment delivery should be used cautiously. The analysis indicates that on a native surface road with a 4 percent gradient and a fully intact Riparian Reserve, reducing cross-drain spacing by one-half from 400 to 200 feet would result in an 80 percent reduction of chronic sediment delivery to stream channels. On a gravel-surface road, the reduction would be 72 percent. This would apply to all alternatives but would vary by the amount of road improved.

Fish habitat improvement projects require in-stream work and would locally deliver relatively small amounts of sediment to streams in the short-term. The types of projects included in this category include placing 3 rock weirs per mile for 8 miles of stream, and placing or falling 15 logs for 8 miles of stream, and replacing 4 culverts for fish passage. Sediment would be delivered to streams via trails created for access. The effects of access trails would be mitigated by completing the project during the in-stream period from June 15 to September 15, when the chance for precipitation and sediment delivery is low. Seeding and mulching of the access trails would also reduce the likelihood of sediment being delivered during a storm event.

The gravel placement in streams would add up to 40 cubic yards of gravel per rock weir at 24 sites. Coarse sediment is lacking in the watershed and this project would provide substrate for channel complexity and fish habitat if the gravels remain in the watershed.

Cumulative Effects

The additional cumulative effects related to this alternative would be an overall reduction in fine sediment from the proposed restoration projects. This alternative would cumulatively reduce the road density in the watershed from 4.7 miles per square mile to 4.5 miles per square mile (see Appendix I). This would have a positive effect on water quality and aquatic habitat in the long-term, but would be negligible at the watershed scale.

Effects of Alternative C on Sediment

Salvage

Direct and Indirect Effects

Under Alternative C, 247 acres would be available for area salvage and 1,078 acres would be available for roadside salvage. The acres available for roadside hazard tree salvage are high estimates because this acreage includes acres below roads with a lower probability of having hazard trees. The roadside hazard tree acres would be salvaged using bull-line. An additional 12 acres of area salvage would use bull-line along with 21 acres of tractor, 123 acres of cable, and 91 acres of helicopter. The likelihood of sediment being delivered to streams is increased because the Riparian Reserves would not have litter and duff intact to filter out sediment if overland flow occurred. However, salvage logging would occur after two winters and the recovery of vegetation in Riparian Reserves would aid in filtering if any sediment moves off-site as a result of salvage. Logging slash would help filter out sediment and dissipate the energy of overland flow.

In areas of moderate burn severity, the majority of trees did not lose their needles from the fire. Since then, the needles have fallen and would provide the soil surface some additional protection from erosion. In areas of high burn severity, there is no additional protection given to the soil through needle fall and those areas would be at a greater risk for erosion. Areas subject to erosion could be 13-31 percent higher if ground-based equipment is used compared to 3 percent if harvest is performed by helicopter.

A study by Chou, et al. in 1994 was unable to detect differences in sediment yields from logged versus unlogged units, mainly due to in unit variability and because sediment produced by the fire was much greater than sediment contributed from post-fire logging (McIver 2001, 164). The amount of erosion and subsequent sedimentation is so great after a large, intense wildfire, that erosion and sedimentation from logging these areas is very difficult to differentiate. However, similar to green tree stands, ground-based skidding generally causes the most compaction and erosion, followed by skyline, and helicopter (McIver 2001, 166). Designated skid trails with 150-foot spacing would result in less than 12 percent disturbance and all cable harvest units would be skyline.

The effects related to the roadside hazard tree removal would come from skidding logs to roads and the use of the roads by trucks and logging equipment. The disturbance, especially from above roads, would create a mechanism for sediment delivery by directly connecting the disturbed area to roadside ditches, many of which are hydrologically-connected. Half these acres, approximately 539 acres, are above roads. These units have the potential to deliver sediment to streams. However, most acres are in low burn severity areas and would not contain many hazard trees to be salvaged. Only trees identified as potential hazard would be salvaged. Because of these conditions and PDFs to water bar corridors after use, these acres would not deliver sediment to streams.

Under Alternative C, approximately 1,078 feet (about 0.2 miles) of temporary road would be constructed. These spur roads would be on ridgetops away from streams and Riparian Reserves. These roads would be ripped, seeded, and mulched after use. No permanent roads would be built under any alternative. This action would add to the short-term road density, but would be negligible at the subwatershed and watershed scale (see Appendix I). These roads would not likely deliver sediment to streams based on their location and because the roads are temporary. The roads would be decommissioned after use by ripping the road surface, seeding, and mulching and consequently reducing erosion to a negligible level.

Restoration

Direct and Indirect Effects

Alternative C would implement a moderate level of restoration projects. Restoration would include higher priority road work within the fire perimeter and lower priority work outside the fire. Projects with a potential to affect sediment levels include road- and culvert-related projects and fish improvement projects. The effects of these activities would be similar to those described in Alternative B but would occur over more miles of roads, at more in-stream sites for fish restoration projects, and over more acres for vegetative treatments.

Road density would be reduced in the watershed by fully decommissioning 33 miles of road and partially decommissioning approximately 2.5 miles of road. An additional 21 miles would be temporarily closed using gates or an earthen berm which would reduce the amount of active roads in the watershed.

The effects from the road work would include a short-term (1-3 years) increase in fine sediment due to disturbing relatively stable or vegetated sites. Roadwork would be completed during the dry season and therefore minimize the likelihood of sediment transport. However, road improvements such as adding rock to roads would reduce sediment in both the short- and long-term. The majority of projects related to roads and culverts are designed to reduce the chronic delivery of fine sediment over time.

Cumulative Effects

The cumulative effects from the salvage and restoration projects would be additive to those effects from the fire and suppression efforts, as well as the past, present, and reasonably foreseeable future actions described in Alternative A. In addition to those impacts, erosion and subsequent sedimentation from ground-based logging systems in the salvage and roadside salvage projects would increase. Because of PDFs to water bar corridors after use, these acres would not deliver sediment to streams. However, road and culvert projects would reduce the long-term chronic fine sediment delivery. Since roads are the greatest concern related to sediment in forested watersheds, the reduction of sediment would be a positive long-term cumulative effect to water quality in the watershed.

This alternative would cumulatively reduce the road density in the watershed from 4.7 miles per square mile to 4.4 miles per square mile (see Appendix I).

The recovery of vegetation on BLM-administered lands would reduce the watershed cumulative effects through time, provided no future disturbances occurred.

Effects of Alternative D on Sediment

Salvage

Direct and Indirect Effects

Under Alternative D, 820 acres would be available for area salvage and 1,064 acres for roadside hazard tree salvage. The amount of sediment delivery due to post-fire logging would be related to the amount of ground disturbed and erosion. The roadside hazard tree acres would be salvaged using bull-line. An additional 19 acres of area salvage would use bull-line, along with 112 acres of tractor, 368 acres of cable, and 321 acres of helicopter. The likelihood of sediment being delivered to streams is increased because the Riparian Reserves would not have litter and duff intact to filter out sediment if overland flow occurred. However, salvage logging would occur after two winters and the recovery of vegetation in Riparian Reserves would aid in filtering if any sediment moves off-site as a result of salvage. Logging slash would help filter out sediment and dissipate the energy of overland flow.

The effects related to roadside hazard tree removal would come from skidding logs to roads. The disturbance, especially from above roads, would create a mechanism for sediment delivery by directly connecting the disturbed area to roadside ditches, many of which are hydrologically-connected. Half these acres, approximately 532 acres, are above roads. These units have the potential to deliver sediment to streams. However, most acres are in low burn severity

areas and would not have many hazard trees to be salvaged. Only trees identified as potential hazards would be salvaged. Because of these conditions and PDFs to water bar corridors after use, these acres would not deliver sediment to streams.

Approximately 3,200 feet (about 0.6 miles) of temporary road would be built under this alternative. The roads would be on ridgetops away from streams and Riparian Reserves. There would be no permanent roads built under this alternative. This action would add to the short-term road density, but would be negligible at the subwatershed and watershed scale (see appendix I). These roads would not deliver sediment to streams based on location and because these roads would be temporary. The roads would be decommissioned after use by ripping the road surface, seeding, and mulching.

Restoration

Direct and Indirect Effects

Alternative D proposes to implement a moderate level of restoration projects. Restoration would include high priority road work within the fire perimeter and lower priority work outside the fire. Projects that would affect sediment levels include road- and culvert-related projects and fish improvement projects. Restoration projects are identical to those proposed in Alternative C. The effects of these activities would be the same as those described in Alternative C.

Road density would be reduced in the watershed by fully decommissioning 33 miles of road and partially decommissioning approximately 2.5 miles of road. An additional 21 miles would be temporarily closed using gates or an earthen berm which would reduce the amount of active roads in the watershed.

The effects from the road work include a short-term (1-3 years) increase in fine sediment due to disturbing relatively stable or vegetated sites. Roadwork would be completed during the dry season to minimize the likelihood of sediment transport. However, road improvements, such as adding rock to roads, would reduce sediment in both the short- and long-term. The majority of projects related to roads and culverts would reduce the chronic delivery of fine sediment over time.

Cumulative Effects

The cumulative effects from salvage and restoration projects would be additive to those effects from the fire and suppression efforts, as well as the past, present, and reasonably foreseeable future actions described in Alternative A. In addition to these impacts, erosion and subsequent sedimentation from ground-based logging systems in the salvage and roadside salvage projects would increase. Because of PDFs to water bar corridors after use, these acres are not likely to deliver sediment to streams. Road and culvert projects would reduce the long-term chronic fine sediment delivery. Since roads are the greatest concern related to sediment in forested watersheds, the reduction of sediment would provide a positive long-term cumulative effect to water quality in the watershed.

This alternative would cumulatively reduce the road density in the watershed from 4.7 miles per square mile to 4.4 miles per square mile (see Appendix I). This would be negligible at the watershed scale.

Effects of Alternative E on Sediment

Salvage

Direct and Indirect Effects

Under Alternative E, 3,269 acres would be available for area salvage and 536 acres for roadside hazard tree salvage. The amount of sediment delivery due to post-fire logging would be related to the amount of ground disturbed and erosion. The roadside hazard tree acres would be salvaged using bull-line. An additional 188 acres of area salvage would use bull-line along with 165 acres of tractor, 853 acres of cable, and 2,063 acres of helicopter. The likelihood of sediment being delivered to streams is increased because the Riparian Reserves would not have litter and duff intact to filter out sediment if overland flow occurred. However, salvage logging would occur after two winters and the recovery of vegetation in Riparian Reserves would aid in filtering if any sediment moves off-site as a result of salvage. Logging slash would help filter out sediment and dissipate the energy of overland flow.

The effects related to roadside hazard tree removal would come from skidding logs to roads. The disturbance, especially from above roads, would create a mechanism for sediment delivery by directly connecting the disturbed area to roadside ditches, many of which are hydrologically-connected. Half these acres, approximately 268 acres, are above roads. These units have the potential to deliver sediment to streams. However, most acres are in low burn severities and would not have many hazard trees to be salvaged. Only trees identified as potential hazards would be salvaged. Because of these conditions and PDFs to water bar corridors after use, these acres would not deliver sediment to streams.

Approximately 8,000 feet (about 1.5 miles) of temporary road would be built under this alternative. The roads would be on ridgetops and not near streams or in Riparian Reserves. The roads would be decommissioned after use by ripping the road surface, seeding, and mulching. This action would add to the short-term road density, but would be negligible at the subwatershed and watershed scale (see Appendix I). These roads would not deliver sediment to streams based on location and because the roads would be temporary.

Restoration

Direct and Indirect Effects

Alternative E has an extensive restoration emphasis. Restoration would include all proposed road projects in the LSR. Projects that would affect sediment levels include road- and culvert-related projects and fish improvement projects. The effects of these activities would be similar to those described in Alternative B, C, and D but would occur over more miles of roads, at more in-stream sites for fish restoration projects, and over more acres for vegetative treatments.

Road density would be reduced in the watershed by fully decommissioning 38 miles of road and partially decommissioning approximately 5.3 miles of road. An additional 21 miles would be temporarily closed using gates or an earthen berm which would reduce the amount of active roads in the watershed. An additional 114 miles of secondary and non-surfaced roads would be closed during the wet season (mid-October to April 30). These actions would reduce the amount of chronic sediment delivery and sediment delivery related to traffic.

The effects from the road work would include a short-term (1-3 years) increase in fine sediment due to disturbing relatively stable or vegetated sites. Roadwork would be completed during the dry season to minimize the likelihood of sediment transport. However, road improvements, such as adding rock to roads, would reduce sediment in both the short- and long-term. The majority of projects related to roads and culverts are designed to reduce the chronic delivery of fine sediment over time.

Cumulative Effects

The cumulative effects from the salvage and restoration projects would be additive to those effects from the fire and suppression efforts, as well as the past, present, and reasonably foreseeable future actions described in Alternative A. The effects would include increased erosion and subsequent sedimentation from ground-based logging systems in the salvage and roadside salvage projects. Because of PDFs to water bar corridors after use, these acres are not likely to deliver sediment to streams. Road and culvert projects would reduce the long-term chronic fine sediment delivery. Since roads are the greatest concern related to sediment in forested watersheds, the reduction of sediment would be a positive long-term cumulative effect to improve water quality in the watershed.

This alternative would cumulatively reduce the road density in the watershed from 4.7 miles per square mile to 4.3 miles per square mile (see Appendix I, Hydrology).

Effects of Alternative F on Sediment

Salvage

Direct and Indirect Effects

Under Alternative F, 213 acres would be available for area salvage and 1,182 acres for roadside hazard tree salvage. The amount of sediment delivery due to post-fire logging would be related to the amount of ground disturbed and erosion. The roadside hazard tree acres would be salvaged using bull-line. An additional 16 acres of area salvage would use bull-line along with 29 acres of tractor, 46 acres of cable, and 122 acres of helicopter.

Under this alternative, trees would be salvaged in 3- to 10-acre pockets of dead trees in green stands. This alternative would protect at-risk soils in large areas of high and moderate burn severity by avoiding disturbance in those stands. This would limit the amount of erosion and subsequent sedimentation created by salvage in those sensitive areas. In stands proposed for salvage, there would be an increase in sediment availability based on the harvest system used. The likelihood of sediment being delivered to streams is low because the green stands surrounding these units would still have litter and duff intact to filter out sediment if overland flow occurred. Logging slash would help filter out sediment and dissipate the energy of overland flow.

The effects related to roadside hazard tree removal would come from skidding logs to roads. The disturbance, especially from above roads, would create a mechanism for sediment delivery by directly connecting the disturbed area to roadside ditches, many of which are hydrologically-connected. Half these acres, approximately 591 acres, are above roads. These units have the potential to deliver sediment to streams. However, most acres are in low burn severity areas and would not have many hazard trees to be salvaged. Only trees identified as potential hazards would be salvaged. Because of these conditions and PDFs to water bar corridors after use, these acres would not deliver sediment to streams.

No new temporary roads would be built under this alternative. There would be no increase in road density as a result of temporary roads built for access to salvage fire-killed trees. This alternative would not increase road density in the short- or long-term (see Appendix I, Hydrology). There would be no additional sediment as a result of temporary roads built for access to salvage fire-killed trees.

Restoration

Direct and Indirect Effects

Alternative F has a focused restoration emphasis. Restoration projects would focus on high priority road work inside the fire perimeter. Planting would occur only in riparian areas and on slopes greater than 65 percent. This would increase the recovery rate of vegetation and thereby increase protection to soil from erosion. Other projects that would

affect sediment levels include road and culvert-related projects.

The effects from the road work include a short-term (1-3 years) increase in fine sediment due to disturbing relatively stable or vegetated sites. Roadwork would be completed during the dry season to minimize the likelihood of sediment transport. However, road improvements, such as adding rock to roads, would reduce sediment in both the short- and long-term. The majority of projects related to roads and culverts are designed to reduce the chronic delivery of fine sediment over time.

This alternative would focus on roadwork inside the fire perimeter. These roads are at the greatest risk for failure and erosion due to the altered hydrology from the fire. These roads are the highest priority in the watershed to improve, renovate, decommission, or close to reduce the amount of sediment in this watershed. This alternative would treat fewer miles of road but focus on the problem areas and those at greatest risk due to changes in the watershed from the fire.

Road density would be reduced in the watershed by fully decommissioning 15.1 miles of road and partially decommissioning approximately 1.4 miles of road. An additional 14 miles would be temporarily closed using gates or an earthen berm which would reduce the amount of active roads in the watershed.

Cumulative Effects

The cumulative effects from the salvage and restoration projects would be additive to those effects from the fire and suppression efforts, as well as the past, present, and reasonably foreseeable future actions described in Alternative A. The additional effects would include increased erosion and subsequent sedimentation from ground-based logging systems in the roadside salvage projects. Because of PDFs to water bar corridors after use, these acres would not deliver sediment to streams. However, road and culvert projects would reduce the long-term chronic fine sediment delivery. Since roads are the greatest concern related to sediment in forested watersheds, the reduction of sediment would be a positive long-term cumulative effect to water quality in the watershed.

The greatest input of sediment will come from the fire itself with the largest amount occurring the first winter. The winter of 2003/2004 will be the second wet season for the watershed since the fire. Much of the area is recovering naturally and with erosion control projects completed under the ESRP. This has reduced the amount of erosion and subsequent sedimentation. Salvage logging would occur after two winters and much of the erosion has been reduced. The recovery of vegetation in Riparian Reserves will act as filters if any sediment moves off-site as a result of salvage.

This alternative would cumulatively reduce the road density in the watershed from 4.7 miles per square mile to 4.5 miles per square mile (see Appendix I, Hydrology).

Effects of Alternative G (Preferred Alternative) on Sediment

Salvage

Direct and Indirect Effects

Under Alternative G, 961 acres would be available for area salvage and 1,188 acres for roadside hazard tree salvage. Proposed research would include 12 units consisting of at least 30 acres in size.

The total amount of salvage for research would consist of 282 acres. Salvage outside the research units would be in areas greater than 10 acres in high and moderate burn severity areas and would occur on 679 acres.

Alternative G would harvest fire-killed trees inside Riparian Reserves in three research units on approximately 11 acres (see Map 3-6). The streams are intermittent, but may have longer flow duration due to decreased evapotranspiration. The extent of ground disturbance, erosion, and subsequent sedimentation would depend on the harvest method used. Ground-based equipment would not be allowed in the Riparian Reserves which would limit the amount of ground disturbance. Yarding corridors may contribute to erosion if logs are not fully suspended. This would result in additional sediment reaching streams due to salvage inside of Riparian Reserves. PDFs requiring full suspension over streams and water bars on yarding corridors in Riparian Reserves would minimize sediment reaching streams. The likelihood of sediment being delivered to streams is increased because the Riparian Reserves would not have litter and duff intact to filter out sediment if overland flow occurred. However, salvage logging would occur after two winters and the recovery of vegetation in Riparian Reserves would aid in filtering if any sediment moves off-site as a result of salvage. Logging slash would help filter out sediment and dissipate the energy of overland flow.

The amount of sediment delivery due to post-fire logging would be related to the amount of ground disturbed and erosion. The 1,188 roadside hazard tree acres would be salvaged using bull-line. An additional 35 acres of area salvage would use bull-line along with 113 acres of tractor, 402 acres of cable, and 411 acres of helicopter.

The effects related to roadside hazard tree removal would come from skidding logs to roads. The disturbance, especially from above roads, would create a mechanism for sediment delivery by directly connecting the disturbed area to roadside ditches, many of which are hydrologically-connected. Half these acres, approximately 594 acres, are above roads. These units have the potential to deliver sediment to streams.

However, most acres are in low burn severity areas and would not have many hazard trees to be salvaged. Only trees identified as potential hazard would be salvaged. Because of these conditions and PDFs to water bar corridors after use, these acres would not deliver sediment to streams.

Approximately 4,490 feet (about 0.9 miles) of temporary road would be built under this alternative. This action would add to the short-term road density, but this would be negligible at the subwatershed and watershed scale (see Appendix I). These spur roads would be on the ridgetop away from streams and Riparian Reserves. These roads would be ripped, seeded, and mulched after use. These roads would not deliver sediment to streams based on location and because the roads would be temporary. The roads would be decommissioned after use by ripping the road surface, seeding, and mulching.

Restoration

Direct and Indirect Effects

Alternative G has a moderate restoration emphasis. Projects with a potential to affect sediment levels include road- and culvert-related projects and fish improvement projects. The effects of these activities would be similar to those described in Alternative B but would occur over more miles of roads and at more sites for in-stream fish restoration projects.

Road density would be reduced in the watershed by fully decommissioning approximately 33 miles of road and partially decommissioning approximately 2 miles of road. An additional 21 miles temporarily closed using gates or an earthen berm would reduce the amount of active roads in the watershed.

The effects from the road work would include a short-term (1-3 years) increase in fine sediment due to disturbing relatively stable or vegetated sites. Roadwork would likely be completed during the dry season and therefore minimize the likelihood of sediment transport. However, road improvements such as adding rock to roads would reduce sediment in both the short- and long-term. The majority of projects related to roads and culverts would reduce the chronic delivery of fine sediment over time.

Cumulative Effects

The cumulative effects from the salvage and restoration projects would be additive to those effects from the fire and suppression efforts, as well as the past, present, and reasonably foreseeable future actions described in Alternative A. Additional effects would include increased erosion and subsequent sedimentation from ground-based logging systems in the salvage and roadside salvage projects. However, road and culvert projects would reduce the long-term chronic fine sediment delivery. Since roads are the greatest concern related to sediment in forested watersheds, the reduction of sediment would be a positive long-term cumulative effect to improve water quality in the watershed.

The greatest input of sediment will come from the fire itself with the largest amount occurring the first winter. The winter of 2003/2004 will be the second wet season for the watershed since the fire. Much of the area is recovering naturally and with erosion control projects completed under the ESRP. This has reduced the amount of erosion and subsequent sedimentation. Salvage logging would occur after two winters and much of the erosion has been reduced.

This alternative would cumulatively reduce the road density in the watershed from 4.7 miles per square mile to 4.4 miles per square mile (see Appendix I, Hydrology).

Temperature

Effects of Alternative A (No Action) on Temperature

Salvage

Direct and Indirect Effects

Under the No Action Alternative, fire-killed trees would not be salvaged. There would be no additional ground disturbance related to salvage under this alternative. No openings would be created in the riparian zone under this alternative. Alternative A would not result in an increase in stream temperature.

Restoration

Direct and Indirect Effects

Under the No Action Alternative, restoration projects would not be implemented. There would be no additional ground disturbance related to restoration. There would be no thinning inside of Riparian Reserves. Alternative A would not contribute to an increase in stream temperature in the Elk Creek Watershed and would not affect streams listed for temperature on the 303(d) list or the beneficial uses occurring in the watershed.

Cumulative Effects

The consumption of stream canopy during the fire increased the amount of shortwave solar radiation reaching the stream channels. The resulting effect is an increase in both maximum and minimum seasonal and diurnal stream temperatures (Johnson 2000, 34). Heavy brushing of roads (i.e., Road number 32-1E-10.1) along perennial streams to create firelines during suppression activities would have affected stream temperature. This activity partially removed riparian canopy and allowed more sunlight to reach the stream. Although there was some removal of riparian canopy as part of suppression efforts, this activity was limited and would not cause stream temperatures to increase noticeably, especially when compared to the increases as a result of the fire.

Riparian Reserves that burned at moderate to high severity, especially along perennial and long-term intermittent

streams, are no longer fully functional due to consumption of canopies by the fire. Although standing snags provide some shade, existing snags would not be sufficient to maintain pre-fire stream temperatures.

The recovery of vegetation in burned riparian areas would likely reduce stream temperatures to pre-fire levels over the next 15-20 years. Areas of back burning, like those on West Branch Elk Creek, burned at a lower intensity through the riparian area than some wildfire areas like those on Flat Creek. Riparian vegetation removal occurred on many of the streams in this watershed during logging operations and for agriculture in the past. The removal of riparian vegetation contributed to elevated stream temperatures in the Elk Creek Watershed. Stream channels scoured to bedrock as a result of the 1964 flood and past practices such as riparian harvest, riparian yarding, and splash damming, also resulted in higher than normal stream temperatures. This elevation in stream temperature is due to the heating of bedrock and the lack of substrate that normally would help maintain cooler temperatures through water storage and groundwater inputs.

Streamside buffers were established by the Oregon Forestry Practices Act (OFPA) for industrial forest lands and the Northwest Forest Plan (NFP) for Federal lands. These buffers have limited or eliminated harvest in the riparian zone and aid in the maintenance of stream shade and, therefore, maintain lower stream temperature. Harvest in riparian zones that would affect stream temperature would not occur on these lands in the future due to the FPA and the NFP. Future commercial and non-commercial thinning within these buffers would be designed to maintain or enhance long-term stream temperature.

Salvage operations after the fire on private lands used stream buffers established by the OFPA. These buffers would aid in the maintenance of stream temperature from forest management activities. The *Sufficiency Analysis: A Statewide Evaluation of Forest Practices Act Effectiveness in Protection Water Quality* determined that current prescriptions in Riparian Management Areas (RMA) on some small and medium Type F and Type N streams may result in short-term temperature increases but the magnitude of the potential increase in temperature at a watershed scale is unknown (ODF and ODEQ 2002, 6). The effects of the fire were the consumption of stream canopy and the resulting increased stream temperatures. The canopy has been consumed by the fire and salvage, especially with stream buffers, would not further reduce canopy and would not increase stream temperatures above those created by the fire.

Effects of Alternative B on Temperature

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage of fire-killed trees would occur so there would be no change in stream temperature from salvage-related activities.

Restoration

Direct and Indirect Effects

Alternative B has a focused restoration emphasis. Vegetative treatments within Riparian Reserves would have the greatest potential of all the restoration projects to affect stream temperatures. Small changes in stream shade due to vegetation removal may be produced by fish habitat improvement projects and road renovation.

Most vegetative treatments would be implemented outside of Riparian Reserves and would maintain stream temperatures. Riparian Habitat Restoration is a vegetative treatment that would occur within Riparian Reserves under this alternative. This proposal would pre-commercially thin in young (10-30 years) stands to increase the rate of growth to achieve LSR characteristics quicker. This would benefit stream temperature in the long-term (15-20 years) by increasing the rate of growth and recovery of shade to stream channels. This project would occur over 117 acres and would maintain a 50-foot no-cut buffer on coho streams and a 30-foot no-cut buffer on all other streams. This no-cut buffer would be sufficient to maintain current stream temperatures through those stream reaches.

Roadwork, especially road renovation, would potentially remove vegetation through brushing within Riparian Reserves. This project would remove shade-providing vegetation where roads parallel streams. This activity would have a negligible effect on stream temperature because understory vegetation along the road would be treated and the overstory canopy would remain intact.

The placement of in-stream fish structures would potentially remove some vegetation within Riparian Reserves. The removal of vegetation would take place when creating access to the stream to place structures or by falling overstory trees into the stream. Both of these activities would be localized and would not likely produce measurable changes in stream temperature.

Planting in high and moderate burn severity in riparian areas would increase the rate of recovery of vegetation and pre-fire stream temperature levels would be achieved sooner but would still take 15-20 years.

Cumulative Effects

The cumulative effects of Alternative B would be additive to those described under the Alternative A. Although vegetation treatments inside Riparian Reserves may occur under this alternative, they would not contribute to increased stream temperatures in the watershed. Streams, whose temperatures would increase due to the fire, would not have additional increases in stream temperature created by this alternative.

Alternative B would not affect streams listed for temperature on the 303(d) list or the beneficial uses occurring in the watershed. Planting of riparian areas would speed up the recovery of vegetation and the recovery of pre-fire stream temperatures.

Effects of Alternative C on Temperature

Salvage

Direct and Indirect Effects

Under Alternative C, 247 acres would be available for area salvage and 1,078 acres for roadside salvage. The acres available for roadside hazard tree salvage are high estimates because this acreage includes acres below roads with a lower probability of having hazard trees.

Both area and roadside hazard salvage would occur outside of Riparian Reserves. Trees within these reserves that are a hazard would be cut but not removed. These reserves are sufficient in maintaining stream temperatures when fully functional and intact. However, many of these reserves have burned at a moderate to high severity and may not provide sufficient shade to maintain pre-fire stream temperatures. Salvage under this alternative would not cause additional changes in stream temperature because salvage would take place outside Riparian Reserves. Currently, a sufficiency analysis of Riparian Reserves is being drafted. The analysis concluded the widths for Riparian Reserves under the NFP are more than sufficient for maintaining and restoring stream temperatures and consequently, water quality standards are being met (USDA and USDI 2003, 12).

Restoration

Direct and Indirect Effects

Alternative C has a moderate restoration emphasis. Projects with the greatest potential to affect stream temperatures would include vegetative treatments in Riparian Reserves. Under this alternative, riparian habitat restoration would involve density management in young stands (10-80 years) to create or enhance LSR characteristics within Riparian Reserves. This treatment would only occur on perennial streams with a 50-foot no-cut buffer on coho streams and a 30-foot no-cut buffer on all other streams. The no-cut buffer and remaining canopy outside the buffer would maintain current stream temperatures. This would benefit stream temperature in the long-term (15-20 years) by increasing the rate of growth and recovery of shade to stream channels.

Cumulative Effects

The cumulative effects of Alternative C would be additive to those described under the No Action Alternative. Although vegetation treatments inside Riparian Reserves would occur under this alternative, they would not contribute to increasing stream temperatures in the watershed. Streams whose temperatures would increase due to the fire would not have additional increases in stream temperature created by this alternative. Alternative C would not affect streams listed for temperature on the 303(d) list or the beneficial uses occurring in the watershed. Planting of riparian areas would speed up the recovery of vegetation and the recovery of pre-fire stream temperatures.

Effects of Alternative D on Temperature

Salvage

Direct and Indirect Effects

Under Alternative D, 820 acres would be available for area salvage and 1,064 acres would be available for roadside salvage. The acres available for hazard tree roadside salvage are high estimates because this acreage includes acres below roads that have a lower probability of having hazard trees available for salvage

Both area and roadside hazard salvage would occur outside of Riparian Reserves. Trees within these reserves that are a hazard would be cut but not removed. These reserves are sufficient in maintaining stream temperatures when fully functional and intact. However, many of these reserves burned at a moderate to high severity and may not provide sufficient shade to maintain pre-fire stream temperatures. Salvage under this alternative would not cause additional changes in stream temperature because salvage would take place outside Riparian Reserves.

Restoration

Direct and Indirect Effects

Alternative D has a moderate restoration emphasis. Projects with the greatest potential to affect stream temperatures would include vegetative treatments in Riparian Reserves. Under this alternative, riparian habitat restoration would involve density management in young stands (10-80 years) to create, accelerate, or enhance LSR characteristics within Riparian Reserves. This treatment would only occur on perennial streams with a 50-foot no-cut buffer on coho streams and a 30-foot no-cut buffer on all other streams. The no-cut buffer and remaining canopy outside the buffer would maintain current stream temperatures. This would benefit stream temperature in the long-term (15-20 years) by increasing the rate of growth and recovery of shade to stream channels.

Cumulative Effects

The cumulative effects of Alternative D would be additive to those described under Alternative A. Although vegetation treatments inside Riparian Reserves may occur under this alternative, they would not contribute to increasing stream temperatures in the watershed. Streams whose temperatures would increase due to the fire would not likely have additional increases in stream temperature created by this alternative. Alternative D would not affect streams listed

for temperature on the 303(d) list. Planting of riparian areas would speed up the recovery of vegetation and, therefore, the recovery of pre-fire stream temperatures.

Effects of Alternative E on Temperature

Salvage

Direct and Indirect Effects

Under Alternative E, 3,269 acres would be available for salvage and 536 acres would be available for roadside salvage. No temporary roads would be built within Riparian Reserves.

Both salvage and roadside hazard salvage would occur outside of Riparian Reserves. These reserves are sufficient in maintaining stream temperatures when fully functional and intact. However, many of these reserves have burned at a moderate to high severity and may not provide sufficient shade to maintain pre-fire stream temperatures. Due to the increased number of acres associated with this alternative, changes in microclimate could occur. These changes in localized temperature could have effects on stream temperature, especially when salvage takes place adjacent to severely burned Riparian Reserves. Salvage would occur outside Riparian Reserves and would not have an effect on stream temperature.

Restoration

Direct and Indirect Effects

Alternative E has an extensive restoration emphasis. Projects with the greatest potential to affect stream temperatures would be vegetative treatments in Riparian Reserves. Under this alternative, riparian habitat restoration would involve density management in young stands (10-80 years) to create or enhance LSR characteristics within Riparian Reserves. This would benefit stream temperature in the long term (15-20 years) by increasing the rate of growth and recovery of shade to stream channels. This treatment would occur on both perennial and intermittent streams with a 50-foot no-cut buffer on coho streams and a 30-foot no-cut buffer on all other streams. The no-cut buffer and remaining canopy outside the buffer would maintain current stream temperatures.

Cumulative Effects

The cumulative effects of Alternative E would be additive to those described under Alternative A. Streams whose temperatures increased due to the fire would not have additional increases in stream temperature created by this alternative. Planting of riparian areas would accelerate the recovery of vegetation and the recovery of pre-fire stream temperatures. Compared to the increase in stream temperatures from the fire, this level of salvage under Alternative E would not have additional increases in stream temperature created by this alternative.

Although vegetation treatments inside Riparian Reserves would occur under this alternative, they would not contribute to increasing stream temperatures in the watershed.

Effects of Alternative F on Temperature

Salvage

Direct and Indirect Effects

Under Alternative F, 213 acres would be available for area salvage and 1,182 acres for roadside hazard tree salvage. No temporary roads would be built under this alternative.

All salvage would occur outside Riparian Reserves under this alternative. Riparian Reserves would maintain current stream temperatures. Stream temperatures would be higher after the fire, but salvage of trees outside the Riparian Reserve would not increase stream temperatures.

Restoration

Direct and Indirect Effects

Alternative F proposes a conservative restoration emphasis that focuses on projects inside the burned area. Projects with the greatest potential to affect stream temperatures would be vegetative treatments in Riparian Reserves. Under this alternative, there would be no riparian habitat restoration and no removal of vegetation within the Riparian Reserve. Planting would occur in riparian areas and would have a long-term benefit to stream temperature by speeding up the recovery rate in the Riparian Reserve. An increase in stream temperature is not expected as a result of the restoration projects under this alternative.

Cumulative Effects

Additional cumulative effects on stream temperature are not expected as a result of Alternative F due to a limited amount of salvage away from high and moderate burn severity areas and no proposed removal of riparian vegetation.

Effects of Alternative G (Preferred Alternative) on Temperature

Salvage

Direct and Indirect Effects

Under Alternative G, 961 acres would be available for area salvage and 1,188 acres for roadside hazard tree salvage. In this alternative, 11 acres of Riparian Reserves would be entered in order to determine effects of salvage on birds. Although this alternative would have the greatest potential to directly affect stream temperatures, it is not expected to change stream temperatures based on the seasonality of the streams that would be affected. “Intermittent streams do not contribute to stream heating during peak temperature time periods, and are not further addressed in this assessment.” (USDA and USDI 2003, 6). Field reviews determined these

streams did not have enough flow to measure summer stream temperature and would not contribute to increases in downstream temperatures.

Although many of the streams that would be chosen are intermittent, at least one is a long-term intermittent stream and could have localized increases in summer stream temperatures as a result of salvage. The Boise Cascade Watershed Analysis did not identify this 2nd order reach as having potential to affect stream temperature (Boise 1999, D-29, Map D-6). Intermittent streams are not flowing during the hot summer months and would not be subject to increased solar radiation during times of high stream temperatures. Long-term intermittent streams may still have some flow during part of the summer, but would not contribute enough flow to have affects on larger streams or at the 6th field subwatershed level would not have additional increases in stream temperature created by this alternative.

Restoration

Direct and Indirect Effects

Alternative G proposes a moderate restoration emphasis. Projects with the greatest potential to affect stream temperatures would be vegetative treatments in Riparian Reserves. Under this alternative, riparian habitat restoration would involve density management in young stands (10-80 years) to create or enhance LSR characteristics within Riparian Reserves. This would benefit stream temperature in the long-term (15-20 years) by increasing the rate of growth and recovery of shade to stream channels. This treatment would only occur on perennial streams with a 50-foot no-cut buffer on coho streams and a 30-foot no-cut buffer on all other streams. The no-cut buffer and remaining canopy outside the buffer would maintain current stream temperatures.

Cumulative Effects

The cumulative effects of Alternative G would be additive to those described under the Alternative A. Streams whose temperatures increased due to the fire would not have additional increases in stream temperature created by this alternative. Planting of riparian areas would accelerate the recovery of vegetation and the recovery of pre-fire stream temperatures. This level of salvage would not have additional affects on stream temperature at the subwatershed and watershed scale and would be monitored to determine changes in stream temperature. Alternative G would not increase stream temperatures in streams on the 303(d) list for temperature and, therefore, would protect the beneficial uses occurring in the watershed.

Channel Morphology

Effects of Alternative A (No Action) on Channel Morphology

Salvage

Direct and Indirect Effects

Under the No Action Alternative, fire-killed trees would not be salvaged. There would be no additional ground-disturbance related to salvage and no changes in channel morphology would occur with this alternative.

Restoration

Direct and Indirect Effects

The No Action Alternative would not implement any restoration projects other than those identified in the ESRP. There would be no additional ground-disturbance related to restoration and no changes in channel morphology as a result of this alternative.

Cumulative Effects

Drainages with large areas (greater than 25 percent) of high and moderate burn severity are at risk for changes in channel morphology. The resulting effects would include increased bank erosion and channel downcutting.

Removal of riparian vegetation during fire suppression activities would destabilize stream banks and cause additional erosion during high flows. This activity was limited and would only have localized effects.

Extensive road building in the past has resulted in the channelization of streams. Roads limit the ability of the stream to adjust or move within its floodplain. Increases in peak flows resulting from high road density can also affect channel morphology by increasing the rate of bank erosion.

Past removal of large wood from streams, riparian harvest, riparian yarding, splash damming, and the 1964 flood have resulted in simplified stream channels. The removal of woody debris has contributed to stream channels being scoured to bedrock.

Structures were placed in streams to attempt to capture substrate and woody debris. Rock weirs were installed in Sugarpine and Hawk creeks on BLM-administered lands. These structures have shown initial signs of success by capturing gravels and adding complexity to the stream channels. Cabled log jams were installed in Flat Creek by private timber companies which have captured some of the excess debris created by the fire. These have also added complexity to the stream. On some of the smaller tributaries, fire-killed trees on BLM-administered lands were felled into streams to provide structure and capture additional sediment. All of these structures benefit stream channels by providing habitat, increasing channel complexity, and dissipating stream energy.

More in-stream structures would be constructed in time by private landowners and the BLM to provide additional structure and habitat. These activities would benefit channel morphology by dissipating energy and decreasing erosion. These structures would cause some localized erosion, but in general would benefit streams by aggrading the channels.

Effects of Alternative B on Channel Morphology

Salvage

Direct and Indirect Effects

Under Alternative B, no area salvage or roadside hazard tree salvage would occur. There would be no effects on channel condition related to salvage.

Restoration

Direct and Indirect Effects

Restoration projects under this alternative with the potential to affect channel morphology include fish habitat improvement projects adding structures for fish habitat, and road-related projects including culvert removal and replacement.
The replacement of four culverts to improve fish passage would be implemented under all action alternatives and therefore would have the same effects for all alternatives. These culvert replacements would improve channel morphology by removing constrictions on these streams and installing structures properly sized for the stream. This would allow the streams to make channel adjustments and would decrease velocities from the current structures.

Placing 3 rock weirs per mile with up to 40 cubic yards of gravel per weir and placing 15 instream log structures per mile over a total of 8 miles would have direct effects on channel morphology. These streams are lacking structure and are simplified due to past management practices and natural events such as flooding. Adding these structures would add channel complexity and dissipate stream energy. These structures would cause some localized erosion, but in general would benefit streams by aggrading the channels. Rosgen gave gravel placement a fair rating in B1 channel types moderately entrenched associated with bedrock or bedrock controlled (Rosgen, 1996, 8-29).

Road stream-crossings at 15 sites would be upgraded due to high risk from debris torrents. In most cases, the culvert size would be increased to the proper size for the stream channel and would create a more stable channel.

Cumulative Effects

The cumulative effects of Alternative B would be additive to those described in the Alternative A. Channel morphology would be improved by adding rock weirs and logs to streams and providing structure to areas currently lacking structure.

Effects of Alternative C on Channel Morphology

Salvage

Direct and Indirect Effects

Under Alternative C, 247 acres would be available for salvage and 1,078 acres for roadside hazard tree salvage. All these acres are outside of Riparian Reserves and would not have any effect on channel morphology. Roadside hazard trees in Riparian Reserves would be felled but not salvaged, except for the portion in the road prism. These may have some effects on channel morphology by causing some localized bank erosion, but adding structure to stream channels would help dissipate energy and capture sediment.

Restoration

Direct and Indirect Effects

Restoration projects under this alternative that would affect channel morphology include fish habitat improvement projects adding structures for fish habitat, road stream-crossing upgrades, and other road-related projects.

Placing 5 rock weirs per mile with gravel placement and adding 20 instream logs per mile over 8 miles would affect channel morphology by adding structure to dissipate energy and add channel complexity. Localized bank erosion would be likely from channel adjustments. These structures would also capture sediment and begin to aggrade the stream channels. This would provide long-term benefit to stream stability and aquatic habitat. Rock weirs would be designed to narrow bedrock channels by causing aggradation on the margins. Adding gravel may speed up this process, although shear stresses may be too great for all gravel to remain in the channel.

Road stream-crossings at 11 sites would be upgraded due to high risk from debris torrents. In most cases, the culvert size would be increased to the proper size for the stream channel and would create a more stable channel.

Cumulative Effects

The cumulative effects of Alternative C would be additive to those described in Alternative A. Channel morphology would not change as a result of the salvage portion of this alternative due to the presence of Riparian Reserves. Channel morphology would be improved by adding rock weirs and logs to streams and providing structure to areas currently lacking structure.

Effects of Alternative D on Channel Morphology

Salvage

Direct and Indirect Effects

Under Alternative D, 820 acres would be available for area

salvage and 1,064 acres for roadside hazard tree salvage. All these acres are outside of Riparian Reserves and would not be expected to have any effect on channel morphology. Roadside hazard trees in Riparian Reserves would be felled but not salvaged, except for the portion in the road prism. These may have some effects on channel morphology by causing some localized bank erosion, but adding structure to stream channels would help dissipate energy and capture sediment.

Restoration

Direct and Indirect Effects

Restoration projects under this alternative that would affect channel morphology include fish habitat improvement projects, adding structures for fish habitat, stream crossing upgrades, and road related projects.

Placing 5 rock weirs per mile with gravel and adding 20 instream logs per mile over 8 miles would add structure to dissipate energy and add channel complexity. Localized bank erosion would be likely from channel adjustments. These structures would also capture sediment and begin to aggrade the stream channels. This would have a long-term benefit on stream stability and aquatic habitat. Rock weirs would be designed to narrow bedrock channels by causing aggradation on the margins. Adding gravel may speed up this process, although shear stresses may be too great for gravel to remain in the channel.

Road stream-crossings at 11 sites would be upgraded due to high risk from debris torrents. In most cases, the culvert size would be increased to the proper size for the stream channel and create a more stable channel.

Cumulative Effects

The cumulative effects of Alternative D would be additive to those described in Alternative A. Channel morphology would not change as a result of the salvage portion of this alternative due to the presence of Riparian Reserves. Channel morphology would be improved by adding rock weirs and logs to streams and providing structure to areas currently lacking structure.

Effects of Alternative E on Channel Morphology

Salvage

Direct and Indirect Effects

Under Alternative E, 3,269 acres would be available for area salvage and 536 acres for roadside hazard tree salvage. Trees on these acres would not be salvaged inside Riparian Reserves so channel morphology would not be affected. Roadside hazard trees in Riparian Reserves would be felled but not salvaged, except for the portion in the road prism. These may have some effects on channel morphology by causing some localized bank erosion, but adding structure to stream channels would help dissipate energy and capture sediment.

Restoration

Direct and Indirect Effects

Restoration projects under this alternative that would affect channel morphology include adding structures for fish habitat improvement projects, road stream-crossing upgrades, and other road-related projects.

Placing 10 rock weirs per mile with gravel and adding 25 instream logs per mile over 8 miles would affect channel morphology by adding structure to dissipate energy and add channel complexity. Localized bank erosion would be likely from channel adjustments. These structures would also capture sediment and begin to aggrade the stream channels. This would provide a long-term benefit to stream stability and aquatic habitat. Rock weirs would be designed to narrow bedrock channels by causing aggradation on the margins. Adding gravel may speed up this process, although shear stresses may be too great for gravel to remain in the channel. Road stream-crossings at 11 sites would be upgraded due to high risk from debris torrents. The culvert size would be increased to the proper size for the stream channel and would create a more stable channel.

Cumulative Effects

The cumulative effects of Alternative E would be additive to those described in Alternative A. Channel morphology would not change as a result of the salvage portion of this alternative due to the presence of Riparian reserves. Channel morphology would be improved by adding rock weirs and logs to streams and providing structure to areas currently lacking structure.

Effects of Alternative F on Channel Morphology

Salvage

Direct and Indirect Effects

Under Alternative F, 213 acres would be available for area salvage and 1,182 acres for roadside hazard tree salvage. All salvage would occur outside of Riparian Reserves. No temporary roads would be built under this alternative. Proposed salvage would not cause changes in channel morphology.

Restoration

Direct and Indirect Effects

Restoration projects with potential to cause changes in channel morphology include adding structures for fish habitat improvement projects, road stream-crossing upgrades, and other road-related projects.

Placing 3 rock weirs per mile with gravel and adding 25 instream logs per mile over 8 miles would affect channel morphology by adding structure to dissipate energy and add channel complexity. Localized bank erosion would be likely from channel adjustments. These structures would also capture sediment and debris and begin to aggrade the stream channels. This would provide a long-term benefit to stream stability and aquatic habitat. Rock weirs would be designed to narrow bedrock channels by causing aggradation on the margins. Adding gravel may speed up this process, although shear stresses may be too great for gravel to remain in the channel.

Road stream-crossings at 26 sites would be upgraded due to high risk from debris torrents. The culvert size would be increased to the proper size for the stream channel and would create a more stable channel.

Cumulative Effects

The cumulative effects of Alternative F would be additive to those described in Alternative A. Channel morphology would not change as a result of the salvage portion of this alternative due to the presence of Riparian Reserves. Channel morphology would be improved by adding rock weirs and logs to streams and providing structure to areas currently lacking structure.

Effects of Alternative G (Preferred Alternative) on Channel Morphology

Salvage

Direct and Indirect Effects

Under Alternative G, 961 acres would be available for area salvage and 1,188 acres for roadside hazard tree salvage. Proposed research would include 12 units consisting of at least 30 acres in size.

The total amount of salvage for research would consist of 282 acres. Salvage outside the research units would occur on 679 acres in areas of high and moderate burn severity greater than 10 acres in size.

Alternative G would harvest 11 acres fire-killed trees inside Riparian Reserves located in research units. These streams are intermittent, but may have longer flow duration due to decreased evapotranspiration. Ground-based equipment would not be allowed in the Riparian Reserves which would limit the amount of ground-disturbance and disturbance to channels. Yarding corridors may contribute to bank erosion if logs are not fully suspended across streams. Requiring full suspension across stream channels would minimize this impact.

The removal of fire-killed trees inside the Riparian Reserve would lower the amount of future LWD in these reserves. This would affect stream channel morphology by limiting the recruitment of large wood in stream channels, which is important for providing structure, dissipating stream energy, and routing sediment. Stream surveys completed in 2003 found that stream reaches within the Riparian Reserves proposed for research salvage had sufficient structure (i.e. LWD and/or boulders) to dissipate stream energy to prevent changes in channel morphology. Some trees may be fallen towards and into the stream channels.

Restoration

Direct and Indirect Effects

Restoration projects under this alternative that would affect channel morphology include adding structures for fish habitat improvement projects, road stream-crossing upgrades, and other road-related projects.

Placing 5 rock weirs per mile with gravel and adding 20 instream logs per mile over approximately 8 miles would affect channel morphology by adding structure to dissipate energy and add channel complexity. Localized bank erosion would be likely from channel adjustments. These structures would also capture sediment and begin to aggrade the stream channels. This would have a long-term benefit to stream stability and aquatic habitat. Rock weirs would be designed to narrow bedrock channels by causing aggradation on the margins. Adding gravel may speed up this process, although shear stresses may be too great for all gravel to remain in the channel.

Road stream-crossings at 11 sites would be upgraded due to high risk from debris torrents. In most cases, the culvert size would be increased to the proper size for the stream channel and create a more stable channel.

Cumulative Effects

The cumulative effects of Alternative G would be additive to those described in Alternative A. Channel morphology would not change as a result of the salvage portion of this alternative due to the presence of Riparian Reserves and the stability of streams based on sufficient structure in stream channels to dissipate stream energy. Channel morphology would be improved by adding rock weirs and logs to streams and providing structure to areas currently lacking structure.

Large Woody Debris (LWD)

Effects of Alternative A (No Action) on Large Woody Debris

Salvage

Direct and Indirect Effects

Under the No Action Alternative, fire-killed trees would not be salvaged. There would be no additional ground-disturbance related to salvage under this alternative and no effects on LWD amounts.

Restoration

Direct and Indirect Effects

The No Action Alternative would not implement any restoration projects. There would be no additional ground-disturbance related to restoration under this alternative and no changes in LWD levels.

Cumulative Effects

Riparian Reserves burned at high or moderate severity would have lower levels of LWD due to the consumption or partial consumption of woody debris. Increases in streamflows resulting from the fire could also remove LWD, especially pieces partially consumed by the fire and no longer stable.

LWD recruitment would increase in the short-term (1-10 years) and would be delayed for many decades until new trees reach maturity and begin to die.

Past removal of LWD from streams, riparian harvest, riparian yarding, and the 1964 flood resulted in low levels of LWD throughout the watershed. These activities produced scouring of stream channels to bedrock. Stream buffers and new logging techniques have eliminated these practices so removal of LWD from streams is unlikely in the future.

Road building has also had an effect on LWD levels in the watershed. Streams have been disconnected by roads acting as dams at each crossing. These road dams have captured decades of coarse gravels and large wood, depriving downstream reaches of these necessary components and resulting in oversimplified channels and degraded habitat.

Salvage logging on industrial forest lands began in 2002 and will continue with approximately 6,000 acres harvested by 2004. These acres include draws, headwalls, and streams that would be buffered under the NFP, but not the FPA. These actions have further reduced the amount of LWD in the watershed as well as the potential for delivery downstream.

Riparian areas burned at a moderate to high severity would provide short-term increases in LWD, but long-term LWD would be reduced for decades until these areas recover.

Efforts to add more LWD to stream channels have occurred on both private and BLM-administered lands and would continue into the future.

Effects of Alternative B on Large Woody Debris

Salvage

Direct and Indirect Effects

Under Alternative B, no area salvage or roadside hazard tree salvage would occur and there would be no effects related to salvage and LWD.

Restoration

Direct and Indirect Effects

Projects under Alternative B that would affect LWD levels include adding instream logs for fish habitat, riparian habitat restoration, and tree planting.

Adding instream logs for fish habitat improvement would increase the amount of LWD by placing 15 logs per mile over 8 miles. This would benefit the streams treated by adding structure to dissipate energy from increased flows and adding habitat complexity to a system currently lacking large wood.

Riparian habitat restoration would include pre-commercial thinning stands 10-30 years old to increase the growth of young trees to provide larger trees sooner. This would accelerate the long-term recruitment of LWD on streams where this treatment occurs. This effect would not be evident for many decades until large trees began to die and fall into stream channels.

Tree planting would occur in high burn severity riparian areas including 50-foot strips on high burn severity fish streams. This project would increase the vegetative recovery rate and the long-term recruitment of LWD, but would also not be evident for many decades.

Cumulative Effects

The cumulative effects of this alternative would be in addition to the past, present, and future actions described in Alternative A. LWD levels would not change at the watershed scale as a result of salvage.

Effects of Alternative C on Large Woody Debris

Salvage

Direct and Indirect Effects

Under Alternative C, 247 acres would be available for area salvage and 1,078 acres for roadside hazard tree salvage. All these acres are outside of Riparian Reserves and would not have any direct effect on LWD levels. Hazard trees identified inside Riparian Reserves would be felled but only the portion in the road prism would be removed, leaving some logs in the Riparian Reserves.

Indirect effects could come from the removal of fire-killed trees in steep areas with some risk of failure. These are the areas that typically deliver large wood and coarse sediment to stream channels. If trees are salvaged from a slide-prone area and a mass wasting event occurs, trees would not make it to stream channels and the potential for localized LWD recruitment would be reduced.

Restoration

Direct and Indirect Effects

Restoration projects that would affect LWD levels under this alternative include fish structure placement, riparian reserve thinning, and planting in Riparian Reserves.

Adding instream logs for fish habitat improvement would increase the amount of LWD by placing 20 logs per mile over 8 miles. Riparian Reserve thinning would increase the rate at which large wood recruitment would be achieved. Planting in Riparian Reserves would increase the vegetative recovery rate and increase the rate at which LWD was produced.

Cumulative Effects

The cumulative effects of this alternative would be in addition to the past, present, and future actions described in Alternative A. LWD levels would not change as a result of salvage at the watershed scale, but could change locally if mass wasting occurs on a salvaged unit.

Additional LWD from restoration projects would increase at a local level, but not at the watershed scale. There are approximately 165 miles of perennial and fish-bearing streams and another 180 miles of long-duration intermittent streams in the watershed. Treating 8 miles of stream would not dramatically increase the levels of LWD in the Elk Creek Watershed. LWD recruitment would increase from fire-killed trees left in Riparian Reserves.

Effects of Alternative D on Large Woody Debris

Salvage

Direct and Indirect Effects

Under Alternative D, 820 acres would be available for area salvage and 1,064 acres for roadside hazard tree salvage. All of these acres are outside of Riparian Reserves and would not affect LWD levels. Hazard trees within the Riparian Reserve would be felled and the portion of tree that lies within the road prism would be removed, leaving some LWD inside the Riparian Reserve.

Indirect effects could come from the removal of fire-killed trees in steep areas with some risk of failure. These areas typically deliver large wood and coarse sediment to stream channels. If trees are salvaged from a slide-prone area and a mass wasting event occurs, trees would not make it to stream channels and would reduce the potential for localized LWD recruitment.

Restoration

Direct and Indirect Effects

Restoration projects that would affect LWD levels under this alternative include fish structure placement, Riparian Reserve thinning, and planting in Riparian Reserves.

Adding instream logs for fish habitat improvement would increase the amount of LWD by placing 20 logs per mile over 8 miles. Riparian Reserve thinning would increase the rate at which large wood recruitment would be achieved. Planting in Riparian Reserves would increase the vegetative recovery rate and the rate at which LWD was produced.

Cumulative Effects

The cumulative effects of this alternative would be in addition to the past, present, and future actions described in Alternative A. LWD levels would not change as a result of salvage at the watershed scale, but could change locally if mass wasting occurs on a salvaged unit.

Additional LWD would be added at a local level from restoration projects, but would not improve the low levels of LWD at the watershed scale. There are approximately 165 miles of perennial and fish-bearing streams and another 180 miles of long-duration intermittent streams in the watershed. Treating 8 miles of stream would not dramatically increase the levels of LWD in the Elk Creek Watershed. LWD recruitment would increase from fire-killed trees left in Riparian Reserves.

Effects of Alternative E on Large Woody Debris

Salvage

Direct and Indirect Effects

Under Alternative E, 3,269 acres would be available for area salvage and 536 acres for roadside hazard tree salvage. There would be no salvage inside Riparian Reserves so LWD levels would not be directly reduced. Salvage would reduce future LWD recruitment in this alternative because of the number of acres salvaged.

Restoration

Direct and Indirect Effects

Restoration projects that would affect LWD levels under this alternative include fish structure placement, Riparian Reserve thinning, and planting in Riparian Reserves.

Adding instream logs for fish habitat improvement would increase the amount of LWD by placing 25 logs per mile over 8 miles. Riparian Reserve thinning would increase the rate at which large wood recruitment would be achieved. Planting in Riparian Reserves would increase the vegetative recovery rate and the rate at which LWD was produced.

Cumulative Effects

The cumulative effects of this alternative would be in addition to the past, present, and future actions described in Alternative A. LWD levels would not change as a result of

salvage at the watershed scale, but could change locally if mass wasting occurs on a salvaged unit.

Additional LWD would be added at a local level from restoration projects, but would not improve the low levels of LWD at the watershed scale. There are approximately 165 miles of perennial and fish-bearing streams and another 180 miles of long-duration intermittent streams in the watershed. Treating 8 miles of stream would not dramatically increase the levels of LWD in the Elk Creek Watershed. LWD recruitment would increase from fire-killed trees left in Riparian Reserves.

Effects of Alternative F on Large Woody Debris

Salvage

Direct and Indirect Effects

Under Alternative F, 213 acres would be available for area salvage and 1,182 acres would be available for roadside hazard tree salvage. All salvage would be outside of Riparian Reserves. No temporary roads would be built under this alternative. Proposed salvage in this alternative would not cause changes in LWD levels.

Restoration

Direct and Indirect Effects

Restoration projects that would affect LWD levels under this alternative include fish structure placement, Riparian Reserve thinning, and planting in Riparian Reserves.

Adding instream logs for fish habitat improvement would increase the amount of LWD by placing 25 logs per mile over 8 miles of stream channel. Riparian Reserve thinning would increase the rate at which large wood recruitment would be achieved. Planting in Riparian Reserves would increase the vegetative recovery rate and the rate at which LWD was produced.

Cumulative Effects

The cumulative effects of this alternative would be in addition to the past, present, and future actions described in Alternative A. LWD levels would not change as a result of salvage at the watershed scale, but could change locally if mass wasting occurs on a salvaged unit.

Additional LWD would be added at a local level from restoration projects, but would not improve the low levels of LWD at the watershed scale. There are approximately 165 miles of perennial and fish-bearing streams and another 180 miles of long-duration intermittent streams in the watershed. Treating 8 miles of stream would not dramatically increase the levels of LWD in the Elk Creek Watershed. LWD recruitment would increase from fire-killed trees left in Riparian Reserves.

Effects of Alternative G (Preferred Alternative) on Large Woody Debris

Salvage

Direct and Indirect Effects

Under Alternative G, 961 acres would be available for area salvage and 1,188 acres for roadside hazard tree salvage. Proposed research would include 12 units consisting of at least 30 acres in size.

The total amount of salvage for research would consist of 282 acres. Salvage outside the research units would be similar to salvage in Alternative E in the high and moderate burn severity areas and would occur on 679 acres.

Alternative G would harvest fire-killed trees inside Riparian Reserves. LWD levels would be directly reduced at a local level. This would occur over 11 riparian acres with approximately 4 of those acres on a 2nd order stream. The other treatments would use the Riparian Reserve acres as part of the treatment reserve and would not lower LWD recruitment levels.

Restoration

Direct and Indirect Effects

Restoration projects that would affect LWD levels under this alternative include fish structure placement, Riparian Reserve thinning, and planting in Riparian Reserves.

Adding instream logs for fish habitat improvement would increase the amount of LWD by placing 20 logs per mile over 5 miles. Riparian Reserve thinning would increase the rate at which large wood recruitment would be achieved. Planting in Riparian Reserves would increase the vegetative recovery rate and the rate at which LWD was produced.

Cumulative Effects

The cumulative effects of this alternative would be in addition to the past, present, and future actions described in Alternative A. Salvage would occur inside 11 acres of Riparian Reserves which would lower LWD levels locally but would not affect LWD levels at the watershed scale.

Additional LWD would be added at a local level from restoration projects, but would not improve the low levels of LWD at the watershed scale. There are approximately 165 miles of perennial and fish bearing streams and another 180 miles of long duration intermittent streams in the watershed. Treating 8 miles of stream would not dramatically increase the levels of LWD in the Elk Creek Watershed. LWD recruitment would increase from fire-killed trees left in Riparian Reserves.

3.4.3.2 Water Quantity

Topics discussed under water quantity include streamflow and channel extension.

Streamflow

Effects of Alternative A (No Action) on Streamflow

Salvage

Direct and Indirect Effects

Under the No Action Alternative, there would be no additional ground disturbance and no change in water quantity. The current conditions of the watershed would remain.

Restoration

Direct and Indirect Effects

No restoration projects would be implemented under the No Action Alternative. There would be no additional ground disturbance related to restoration and no changes in streamflow as a result of this alternative.

Cumulative Effects

The Timbered Rock Fire burned approximately 10,660 acres at a moderate to high burn severity. These levels of burn severity removed all or most of the litter layer. The litter layer reduces the amount of runoff and erosion during storm events. With the litter layer removed, runoff and erosion would increase on these acres. Areas of concern in relation to increased runoff as a result of the fire would be high and moderate burn severity acres. This concern would be greatest inside the transient snow zone (TSZ), an elevation band from 3,500 to 5,000 feet, due to the high probability of Rain-on-Snow (ROS) events. Large openings in the TSZ can cause increases in the timing and magnitude of peak flows due to additional snowpack accumulation (see Appendix I, Hydrology).

The reduction of evapotranspiration due to the loss of vegetation over 10,660 acres would also contribute to changes in the timing and magnitude of peak flows. Peak flows would arrive sooner and be of greater magnitude, causing more streambank erosion and degrading aquatic habitat.

Fireline construction during fire suppression activities would increase runoff due to compaction. This effect was reduced by water-barring and pulling organic debris back onto firelines.

Past activities in the watershed that contributed to changes in streamflow include logging and road building. Large areas of clearcut, both inside and outside the TSZ, contributed to increased runoff and streamflow. The high road density in this watershed contributes to compaction and runoff.

Decades of fire exclusion have led to higher densities of vegetation and higher rates of evapotranspiration. Due to this increase in evapotranspiration, streamflows may actually have been lower before the fire than historically occurred. Decades of fire exclusion has also led to an increase in fuel loadings leading to larger, more catastrophic fires, like the Timbered Rock Fire, which caused an increase in runoff and streamflow. Watershed responses are very difficult to quantify. Many variables can produce different effects depending on the circumstance.

The simplified stream channels and large reaches of bedrock in this watershed have resulted in a lack of groundwater storage in streambanks. This resulted in reduced summer low flows due to the lack of recharge from groundwater to streams. This also has a negative effect on water quality.

Effects of Alternative B on Streamflow

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur. There would be no additional changes in evapotranspiration rates related to salvage under this alternative and no changes in streamflow.

Restoration

Direct and Indirect Effects

Alternative B has a focused restoration emphasis. Activities affecting stream flow would involve removing vegetation, changes in canopy closure, and planting vegetation.

Thinning in the watershed would occur in several projects. All would have the same relative effects on streamflow. The level of thinning in this alternative would be 1,375 acres and would not cause measurable increases in streamflow. Additional available water would be used by remaining vegetation.

Cumulative Effects

The cumulative effects from this alternative would be additive to those effects from the fire and suppression efforts, as well as the past, present, and reasonably foreseeable future actions described in Alternative A. There would not be measurable additional changes in streamflow as a result of this alternative, especially when compared to the potential increase as a result of the fire.

Effects of Alternative C on Streamflow

Salvage

Direct and Indirect Effects

Under Alternative C, 247 acres would be available for area salvage and 1,078 acres for roadside salvage. Salvage of fire-killed trees would not affect water yield and streamflow. Evapotranspiration has decreased as a result of the fire and salvaging dead trees would not further change evapotranspiration rates.

Salvage logging would not affect canopy closure; the canopy has been burned by the fire and no longer is intact. Salvage logging would not increase this effect because the canopy has already been reduced.

Approximately 1,100 feet (0.2 miles) of temporary road would be built under this alternative. The roads proposed would generally be located on the ridgetop and would not be near streams or in Riparian Reserves. Water yield would not likely increase.
No permanent road building is proposed in this project. The amount of temporary road building and landing construction in the TSZ is very small and would not have a pronounced impact on peak flows at the watershed or subwatershed scales.

Restoration

Direct and Indirect Effects

Alternative C has a moderate restoration emphasis. Activities affecting streamflow would involve removing vegetation, and the subsequent changes in canopy closure, and planting vegetation.

Thinning would occur in several projects. All these projects would have the same relative effects on streamflow. The level of thinning in this alternative would not cause increases in streamflow because of the spatial distribution of units, and the remaining canopy closure. Additional available water would be used by the remaining vegetation.

Cumulative Effects

The cumulative effects from this alternative would be additive to those effects from the fire and suppression efforts, as well as the past, present, and reasonably foreseeable future actions described in Alternative A. Additional changes in streamflow as a result of this alternative would not be measurable, especially when compared to the potential increase as a result of the fire.

Effects of Alternative D on Streamflow

Salvage

Direct and Indirect Effects

Under Alternative D, 820 acres would be available for area salvage and 1,064 acres for hazard tree roadside salvage. Salvage of fire-killed trees would not likely affect water yield and streamflow. Evapotranspiration has decreased as a result of the fire, and salvaging dead trees would not further change evapotranspiration rates.

Salvage logging would not affect canopy closure; the canopy has been burned by the fire and no longer is intact. Salvage logging would not increase this effect because the canopy has already been reduced.

Approximately 3,200 feet (0.6 miles) of temporary road would be built under this alternative. The roads would be on the ridgetop and not near streams or in Riparian Reserves. Water yield would not likely increase unless these roads were located mid-slope.

No permanent road building is proposed in this project. The amount of temporary road building and landing construction in the TSZ is very small and would not have a pronounced impact on peak flows at the watershed or subwatershed scales.

Restoration

Direct and Indirect Effects

Alternative D has a moderate restoration emphasis. Activities affecting streamflow involve removing vegetation, and the subsequent changes in canopy closure, and planting vegetation.

Thinning would occur in several projects. All would have the same relative effects on streamflow. The level of thinning in this alternative would not cause increases in streamflow due to the additional water available being used by remaining vegetation, the spatial distribution of units, and the remaining canopy closure.

Cumulative Effects

The cumulative effects from this alternative would be additive to those effects from the fire and suppression efforts, as well as the past, present, and reasonably foreseeable future actions described in Alternative A. There would not be measurable additional changes in streamflow as a result of this alternative, especially when compared to the potential increase as a result of the fire.

Effects of Alternative E on Streamflow

Salvage

Direct and Indirect Effects

Under Alternative E, 3,269 acres would be available for area salvage and 536 acres for roadside hazard tree salvage. Salvage of fire-killed trees would not affect water yield and streamflow. Evapotranspiration has decreased as a result of

the fire, and salvaging dead trees would not further change evapotranspiration rates.

Approximately 8,000 feet (1.5 miles) of temporary road would be built under this alternative. The roads would be on the ridgetop and not near streams or in Riparian Reserves. Water yield would not likely increase unless these roads were located mid-slope.

Restoration

Direct and Indirect Effects

Alternative E has an extensive restoration emphasis. Activities affecting stream flow involve removal of vegetation, and the subsequent changes in canopy closure, and planting vegetation.
Thinning would occur in several projects. All would have the same relative effects on streamflow. The level of thinning in this alternative would not cause increases in streamflow because of the spatial distribution of units and the remaining canopy closure. The additional available water would be used by remaining vegetation.

Cumulative Effects

The cumulative effects from this alternative would be additive to those effects from the fire and suppression efforts, as well as the past, present, and reasonably foreseeable future actions described in Alternative A. Additional changes in streamflow as a result of this alternative would not be measurable, especially when compared to the potential increase as a result of the fire.

Effects of Alternative F on Streamflow

Salvage

Direct and Indirect Effects

Under Alternative F, 213 acres would be available for area salvage and 1,182 acres for roadside hazard tree salvage. Salvage of fire-killed trees would not affect water yield and streamflow. Evapotranspiration has decreased as a result of the fire, and salvaging dead trees would not further change evapotranspiration rates.

No new temporary roads would be built under this alternative. There would be no changes in streamflow as a result of temporary roads built for access to salvage fire-killed trees.

Restoration

Direct and Indirect Effects

Alternative F has a focused restoration emphasis. Activities affecting streamflow involve removal of vegetation, and the resulting changes in canopy closure, and planting vegetation.

Thinning would occur in several projects. All would have the same relative effects on streamflow. The level of thinning in this alternative would not cause increases in streamflow. The additional available water would be used by the remaining vegetation.

Planting would accelerate the recovery rate to pre-fire streamflow levels.

Cumulative Effects

The cumulative effects from this alternative would be additive to those effects from the fire and suppression efforts, as well as the past, present, and reasonably foreseeable future actions described in Alternative A. Additional changes in streamflow as a result of this alternative would not be measurable, especially when compared to the potential increase in streamflow as a result of the fire.

Effects of Alternative G (Preferred Alternative) on Streamflow

Salvage

Direct and Indirect Effects

Under Alternative G, 961 acres would be available for area salvage and 1,188 acres for roadside hazard tree salvage. Salvage of fire-killed trees would not affect water yield and streamflow. Evapotranspiration has decreased as a result of the fire, and salvaging dead trees would not further change evapotranspiration rates.

Salvage logging would not affect canopy closure; the canopy has been burned by the fire and is no longer intact. Salvage logging would not increase this effect because the canopy has already been reduced. The canopy would not be reduced inside the TSZ from salvage logging because the canopy in high and moderate burn severity areas has already been consumed. There would not be measurable increases in streamflow from salvage logging when compared to the increases related to the fire alone.

Approximately 4,500 feet (0.9 miles) of temporary road would be built under this alternative. The roads would be on the ridgetop and not near streams or in Riparian Reserves. Water yield would not likely increase unless these roads were located mid-slope.

No permanent road building is proposed in this project. The amount of temporary road building and landing construction in the TSZ is very small and would not have a pronounced impact on peak flows at the watershed or subwatershed scales.

Restoration

Direct and Indirect Effects

Alternative G has a moderate restoration emphasis. Activities affecting streamflow involve removal of vegetation, and the subsequent changes in canopy closure, and planting vegetation.

Thinning would occur in several projects. All would have the same relative effects on streamflow. The level of thinning in this alternative would not cause increases in streamflow because of the spatial distribution of units, and the remaining canopy closure. The additional available water would be used by the remaining vegetation,

Planting would accelerate the recovery rate to pre-fire streamflow levels.

Cumulative Effects

The cumulative effects from this alternative would be additive to those effects from the fire and suppression efforts, as well as the past, present, and reasonably foreseeable future actions described in Alternative A. Additional changes in streamflow as a result of this alternative would not be measurable, especially when compared to the potential increase in streamflow as a result of the fire.

Channel Extension

Effects of Alternative A (No Action) on Channel Extension

Salvage

Direct and Indirect Effects

Under the No Action Alternative, no salvage would occur. There would be no additional ground disturbance and no change in channel extension. The current conditions of the watershed would remain.

Restoration

Direct and Indirect Effects

Restoration projects would not implement the No Action Alternative. There would be no additional ground-disturbance related to restoration and no changes in channel extension as a result of this alternative.

Cumulative Effects

Due to the increase in discharge as a result of the fire, the extension of stream channels by roads would also increase. Mid-slope roads change sub-surface flow into surface flow which also increases the stream channel network.

Compaction from firelines used during fire suppression activities would extend stream channels. This effect was reduced by water-barring and pulling organic debris back onto firelines. Opening up roads for fire access would also increase the connectivity of roads to streams.

Road building related to past logging activities contributed to changes in channel extension. The road density is high in this watershed which contributes to compaction and runoff. Lack of road maintenance in the watershed has resulted in poor drainage relief and failing structures. These all add to the extension of stream channels.

Effects of Alternative B on Channel Extension

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur. There would be no additional changes in the road network related to salvage under this alternative so there would be no changes in stream channel extension.

Restoration

Direct and Indirect Effects

Alternative B has a focused restoration emphasis. Road-related projects could affect channel extension.

Road improvement would occur over 24 miles and renovation would occur over 76 miles. Improvement involves upgrading a road by adding rock to the surface whereas renovation does not. Adding rock to a road surface decreases the flow path which decreases channel extension.

Adding cross-drains would occur in both treatments; however renovation may only include brushing which would have no affect on channel extension. Adding cross drains would also reduce the amount of channel extension and the hydrologic connectivity of roads by routing the water onto the forest floor instead of carrying it in the ditchline to stream channels.

Cumulative Effects

Alternative B would reduce some of the cumulative effects from the fire, fire suppression, and other past activities that have lead to channel expansion by decreasing the distance water flows in the ditch or on the road.

Effects of Alternative C on Channel Extension

Salvage

Direct and Indirect Effects

Under Alternative C, approximately 1,078 feet (0.2 miles) of temporary roads would be built. The proposed roads would be located on the ridgetop and not near streams or in Riparian Reserves. They would be decommissioned after use and would not increase the hydrologic connectivity of road or cause additional channel extension.

Restoration

Direct and Indirect Effects

Road improvement would occur over 24 miles and renovation would occur over 76 miles. Improvement involves upgrading a road by adding rock to the surface

whereas renovation does not. Adding rock to a road surface decreases the flow path which decreases channel extension.

Adding cross-drains would occur in both treatments; however renovation may only include brushing which would have no affect on channel extension. Adding cross-drains would also reduce the amount of channel extension and the hydrologic connectivity of roads by routing the water onto the forest floor instead of carrying it in the ditchline to stream channels.

Cumulative Effects

Alternative C would reduce some of the cumulative effects from the fire, fire suppression, and other past activities that have lead to channel extension by decreasing the distance water flows in the ditch or on the road.

Effects of Alternative D on Channel Extension

Salvage

Direct and Indirect Effects

Under Alternative D, approximately 3,200 feet (0.6 miles) of temporary roads would be built. The roads would be on the ridgetop and not near streams or in Riparian Reserves. They would be decommissioned after use and would not increase the hydrologic connectivity of roads or cause additional channel extension.

Restoration

Direct and Indirect Effects

Road improvement would occur over 24 miles and renovation would occur over 76 miles. Improvement involves upgrading a road by adding rock to the surface whereas renovation does not. Adding rock to a road surface decreases the flow path which decreases channel extension.

Adding cross-drains would occur in both treatments; however renovation may only include brushing which would have no affect on channel extension. Adding cross-drains would also reduce the amount of channel extension and the hydrologic connectivity of roads by routing the water onto the forest floor instead of carrying it in the ditchline to stream channels.

Cumulative Effects

Alternative D would reduce some of the cumulative effects from the fire, fire suppression, and other past activities that have lead to channel extension by decreasing the distance which water flows in the ditch or on the road.

Effects of Alternative E on Channel Extension

Salvage

Direct and Indirect Effects

Under Alternative E, approximately 8,000 feet (1.5 miles) of temporary roads would be built. The roads would be on the ridgetop and not near streams or in Riparian Reserves. They would be decommissioned after use and would not increase the hydrologic connectivity of roads or cause additional channel extension.

Restoration

Direct and Indirect Effects

Road improvement would occur over 28.8 miles and renovation would occur over 86.6 miles. Improvement involves upgrading a road by adding rock to the surface whereas renovation does not. Adding rock to a road surface decreases the flow path which would decrease channel extension.

Adding cross-drains would occur in both treatments; however renovation may only include brushing which would have no affect on channel extension. Due to this, the large increase in renovation in this alternative may not contribute to a large decrease in channel extension when compared to other alternatives. Adding cross-drains would also reduce the amount of channel extension and the hydrologic connectivity of roads by routing the water onto the forest floor instead of carrying it in the ditchline to stream channels.

Cumulative Effects

Alternative E would reduce some of the cumulative effects from the fire, fire suppression, and other past activities that have lead to channel extension by decreasing the distance which water flows in the ditch or on the road.

Effects of Alternative F on Channel Extension

Salvage

Direct and Indirect Effects

No new temporary roads would be built under this alternative so channel extension would not be reduced.

Restoration

Direct and Indirect Effects

Road improvement would occur over 23.8 miles and renovation would occur over 44.5 miles. Improvement involves upgrading a road by adding rock to the surface whereas renovation does not. Adding rock to a road surface decreases the flow path which would decrease channel extension.

Adding cross-drains would occur in both treatments; however renovation may only include brushing which would

have no affect on channel extension. Adding cross-drains would also reduce the amount of channel extension and the hydrologic connectivity of roads by routing the water onto the forest floor instead of carrying it in the ditchline to stream channels.

Cumulative Effects

Alternative F would reduce some of the cumulative effects from the fire, fire suppression, and other past activities that have lead to channel extension by decreasing the distance which water flows in the ditch or on the road.

Effects of Alternative G (Preferred Alternative) on Channel Extension

Salvage

Direct and Indirect Effects

Under Alternative G, approximately 4,500 feet (0.9 miles) of temporary roads would be built. The roads would be on the ridgetop and not near streams or in Riparian Reserves. These temporary roads would be decommissioned after use and would not increase the hydrologic connectivity of road or cause additional channel extension.

Restoration

Direct and Indirect Effects

Road improvement would occur over 24.4 miles and renovation would occur over 52.3 miles. Improvement involves upgrading a road by adding rock to the surface whereas renovation does not. Adding rock to a road surface decreases the flow path which would decrease channel extension.

Adding cross-drains would occur in both treatments; however renovation may only include brushing which would have no affect on channel extension. Adding cross-drains would also reduce the amount of channel extension and the hydrologic connectivity of roads by routing the water onto the forest floor instead of carrying it in the ditchline to stream channels.

Cumulative Effects

Alternative G would reduce some of the cumulative effects from the fire, fire suppression, and other past activities that have lead to channel extension by decreasing the distance which water flows in the ditch or on the road.

3.5 Fisheries

- The results of biological studies vary and literature is inconsistent about the effects of disturbances such as fire, harvest, and roads on fish populations.
- Salmon and trout populations are very adaptive and nomadic and respond well to disturbance events.
- After a disturbance, remnant or minimal populations are usually maintained within the range of natural variability, and are largely dependent upon habitat complexity.
- Habitat complexity, especially large woody debris, can minimize adverse effects from disturbances (Harmon, et al. 1986; Everest, et al. 1972, 91-100; Meehan 1991, 521-530).
- Fish habitat and populations usually begin to rebound to a viable level within the first year and/or short-term (5 years) from a disturbance
- Disturbances cause trade-offs in habitat and fish.
- Populations in the short- and long-term maintain at a level within the range of natural variability at a drainage and watershed scale.
- Salvage and other harvest have a negligible to nil effect to fish populations when Riparian Reserves remain.
- Restoration projects would improve watershed conditions and have short-term adverse and long-term beneficial effects to aquatic life for all alternatives.

3.5.1 Methodology

Literature related to fisheries, timber harvest, road activities, and fire were used and cited. Information was obtained from GIS, maps, aerial photos, macroinvertebrate monitoring data, stream inventories, fish presence surveys in 1965 and the 1990s, and field observations (ODFW 1991; ODFW 1994; USDA and USDI 1996, Appendix K). Most information is from the last decade.

The BLM and USFS Elk Creek Watershed Analysis and Boise Cascade Elk Creek Watershed Analysis were used extensively for background information. This analysis primarily includes three subwatersheds: West Branch Elk, Flat, and Sugarpine creeks within the Elk Creek Watershed (see Appendix J).

3.5.1.1 Assumptions

The following assumptions are used in this analysis:

1. Improved habitat complexity correlates to improved fish survival and production (Hartman, et al. 1996, 237, 243, 248; Reeves, et al. 1993, 314; Bustard and Narver 1975b, 684, 686; Tschaplinski and Hartman 1983, 452;

Murphy, et al. 1986, 1526; Hartman and Brown 1987, 262).

2. Fish populations:
   a. are dynamic, adaptive, and move throughout the watershed (Chapman 1962, 1047, 1077, 1078; Reeves, et al. 1995, 337);
   b. recover and reproduce in drainages after timber harvest, fire events, and other disturbances (Hall and Lantz 1969, 1; Hartman and Scrivener 1990, 119-135; Holtby 1988, 502-514);
   c. maintain a near remnant population level within the range of natural variability after a disturbance.
3. Fish prefer cover more than food in the winter and the opposite in the summer (Murphy and Hall 1981, 141-143).
4. Timber harvest effects to fish are minimal with Northwest Forest Plan Riparian Reserves in place, compared to logging practices in past decades (Hall and Lantz 1969, 355; Hartman and Scrivener 1990, 1; Holtby 1988, 502-514).

3.5.2 Affected Environment

The presence of anadromous fish is a major reason the Elk Creek Watershed is designated a Tier One Key Watershed in the Northwest Forest Plan. Key Watersheds contribute to the conservation of anadromous salmon, steelhead, and trout and are high priority areas for watershed restoration. Fish species found in the Elk Creek Watershed include fall and spring chinook and coho salmon, winter and summer steelhead trout, and cutthroat trout (see Map 3-9). See Appendix J, Fisheries, for fish population trend figures. The National Marine Fisheries Service (now known as NOAA-Fish) listed wild coho salmon as a threatened species in May 1997.

3.5.2.1 Populations

Fish population health is influenced by natural and human-caused disturbances. The degree of health for a population is determined by the extent a population can reproduce and maintain itself in a watershed or basin as a renewable resource**.** Primary issues for fish population health include sedimentation, instream and riparian cover, and channel stability. Primary limiting factors for fish survival and production include lack of instream large woody debris, undersized culverts, chronic erosion from natural surface roads, and stream bank erosion.

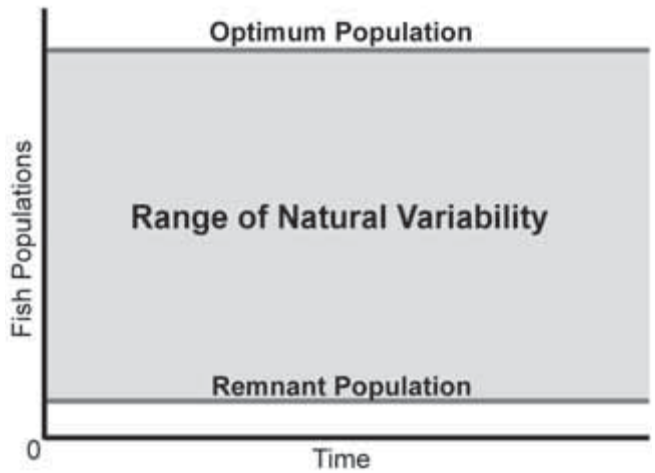
Population Trends

Pre-fire

Limited information is available on Elk Creek related to current and historic populations. The most recent data available is from the ODFW trap and haul program for 1993-1994 which shows adult coho numbers increased from less than 100 to over 1,200 from 1993 to 2003. The best historic data is from the Elk Creek Dam EIS (USACE 1980) (see Appendix J, Fisheries).

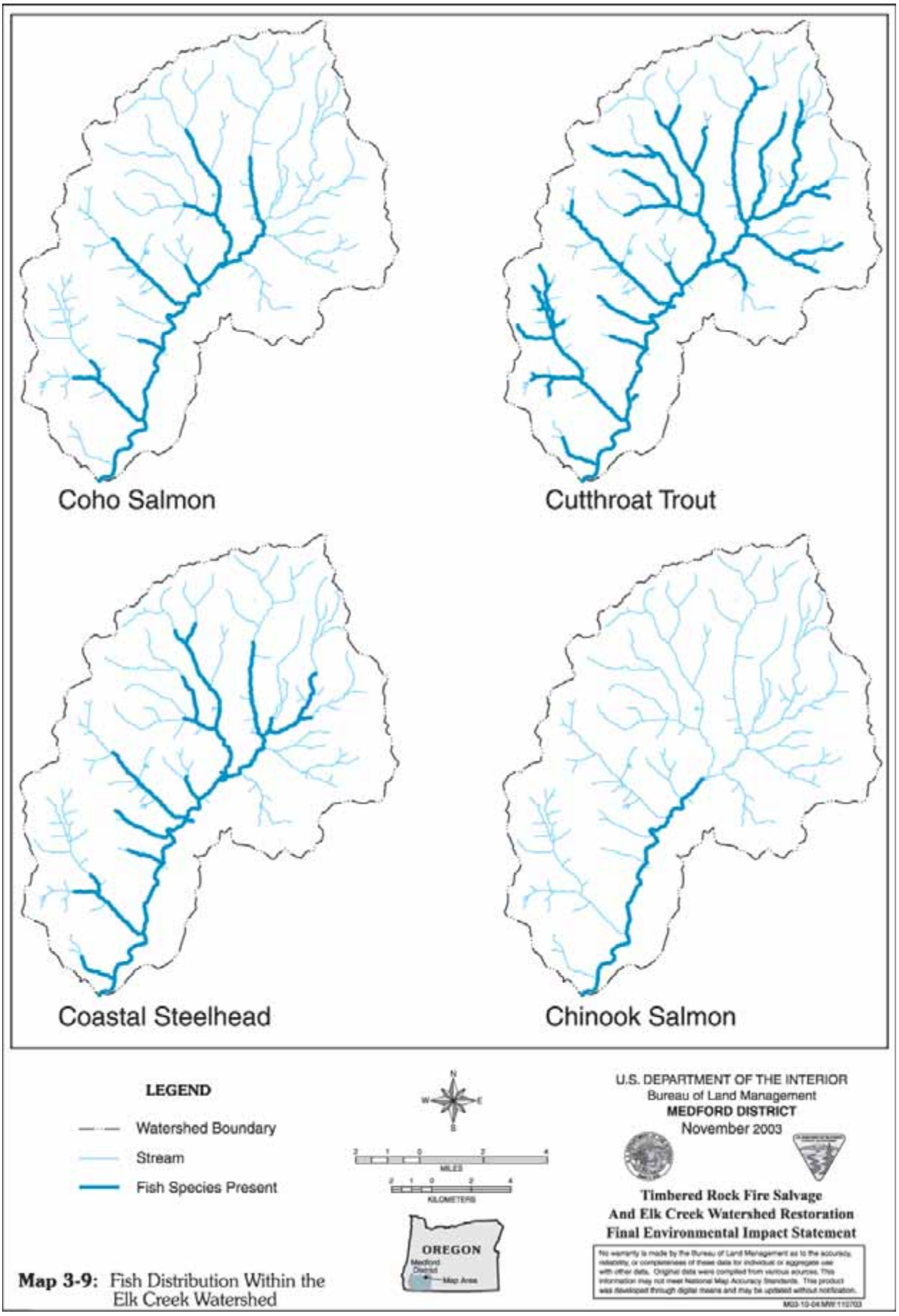
Coho salmon, steelhead, and trout populations in the Elk Creek Watershed are presently closer to remnant than a near optimal level. However, adult coho and steelhead population trends have increased over the decades in the Elk Creek Watershed (see Appendix J). Trout populations are highly variable from year to year. The ability for salmon and trout to survive is attributed to their productivity, ability to adapt easily, and ability to rebound quickly from large disturbances (Rieman, et al. no date, 13; Reeves, et al. 1995, 340; Minshall, et al. 1989, 111-119, 707-714; Minshall 2003, 155-161; Gresswell 1999, 193-215). Notwithstanding decades of timber harvest and road construction, trout and coho populations maintain a minimal or near remnant viable level (Minshall 2003, 155-161)(see Figure 3.5-1).

Figure 3.5-1. Range of Natural Variability



Range of natural variability includes the fluctuations of historical disturbance events between a near optimal and remnant population level. Disturbance events can be catastrophic (fire) and non-catastrophic (timber harvest-related activities). Population levels are largely dependent upon the level of habitat complexity which fluctuates with these disturbances. Near optimal population levels are not sustained for very long because of the constant changes in the watershed. Near optimal conditions are not always common in a wilderness condition. A pristine situation includes catastrophic or pulse events which cause habitat and populations to fluctuate. These fluctuations are within the range of natural variability for habitat complexity and fish population viability (Gresswell 1999, 193-215; Minshall, Robinson, and Lawrence 1987, 709-710; Swanson, et al. 1994, 80-90; Mason 1976, 775-788; Hartman 1965, 135-181).

Coho salmon surveys were conducted to substantiate the effectiveness of rock weirs previously installed by the BLM in the Sugarpine Creek drainage. Qualitative information was collected from 1999 to 2002 for juvenile coho salmon



Map 3-9: Fish Distribution Within the Elk Creek Watershed

in Sugarpine and Hawk creeks. Average abundances in Sugarpine Creek indicate an increase in subyearling and yearling coho, approximately 0-2 and 0-.02 fish per square meter, respectively. There was a slight increase in yearling fish in Hawk Creek (0-.004 fish per square meter). The numbers of subyearling coho in Hawk Creek (0-1.5 fish per square meter) are higher than typically seen in the literature when compared to normal abundances in Coastal Oregon streams. The numbers of yearling coho are not as high as typically seen in the literature (Marshall 1990,15), primarily because of the absence of rearing pool habitat. Pool habitat and spawning gravel amounts are poor throughout the watershed and are a limiting factor in fish production (Nickleson, et al. 1986, 2447)(see Appendix J, Fisheries).

Information on West Branch Elk, Flat, and Sugarpine creeks depicts good numbers of coho spawners and lower than desired numbers of juveniles. Assuming the streams are fully seeded or reached capacity for spawners, the major limiting factor for fish production is the lack of complex habitat and food abundance. This situation for juvenile fish tends to yield minimal subyearling production and few yearlings. The yearling fish require a more complex habitat.

Extended high temperatures, greater than 77° F, can have an indirect negative effect on survival for juvenile fish. Fish population survival and production can decrease to a remnant level because of high stream temperatures over the long-term, especially in poor habitat conditions. Short-term periodic high temperatures are part of the natural variability in the fish life cycle. Streams in the watershed experience diurnal fluctuations which can have a greater effect on fish than short-term increases. Diurnal fluctuations in Hawk and Sugarpine creeks were moderate in summer months approaching levels which may slow juvenile fish growth more than adversely affect fish abundance (see Appendix J).

Post-Fire

The Timbered Rock Fire may have affected fish in the following streams: West Branch, Alco, Flat, Upper Sugarpine, Middle, and mainstem Elk creeks. During the fire, fish distribution probably changed as fish, especially yearlings and adults, moved downstream to larger water bodies or sought springs for cooler water. Based on field observations of juvenile fish, moderate to high burn severity had little effect on fish in streams such as West Branch Elk, Flat, or Sugarpine creeks. Juvenile and spawning fish have been observed after the fire in those creeks.

Fish mortality and substantial effects to populations occur from highly severe and extensive fires in a watershed (Rieman and Clayton 1997, 11; Rieman, et al. 1997, 47-55). These conditions can produce fish mortality from high water temperatures in 1st and 2nd order streams (Minshall, et al. 1989, 708). Mortality was not uniform and surviving fish migrated back into streams after the fire. The cause of fire-related fish mortalities is not often established (Minshall, Brock, and Varley 1989, 707; Minshall, et al. 1990, 111-119; McMahon and deCalesta 1990, 234; Rieman, et al. 1997, 12). Few cases show increased water temperature is a direct cause of mortality. It is doubtful 3rd order streams are affected by elevated water temperatures (Minshall and Brock 1991, 710). Streams in the burned area typically have a maximum temperature range from 61-73° F (Boise 1999). Fish mortality usually would not occur unless temperatures were approximately 11-14° F higher for an extended time period or approximately 10-14 days. This varies by species; trout are less tolerant than coho salmon. Fish populations tend to respond to changes in temperature and move upstream or downstream to more suitable temperatures (Gresswell 1999, 193-200; McMahon and deCalesta 1990, 233; Rieman and Clayton 1997, 8-9).

Fire effects to aquatic life are determined by the intensity and size of the fire. Effects of fire on fish and insects may be direct and immediate (Yount and Niemi 1990, 547). Localized direct mortality to trout and insects was noted in the 1988 Yellowstone fire but was not uniform (Minshall and Brock 1991, 708). Post-fire indirect effects are dependent on fire severity, geology, topography, size of watershed, and precipitation events (Swanson 1981; Meyer, et al. 1992; Gresswell 1999, 194, 195, 199).

Fish survive because of their ability to persevere throughout a range of environmental conditions. Generally, fish populations survive fires because connectivity in the watershed exists and there are sufficient numbers of fish to repopulate. Where populations are not isolated, they recover rapidly, whether there is total or partial elimination in an area. Trout and returning salmon would repopulate and move from one drainage to another. Post-fire, juvenile coho salmon abundance is higher in neighboring Bitter Lick Creek, outside the fire area. This could be due to an increase in adult escapement or fish movement during the fire. Fish populations tend to maintain survival and production as a result of a fire. The most adverse effects from the fire occur from fireline and road construction during suppression (Bisson, Nielson, and Ward 1988, 322-335; Minshall, et al. 1990, 111-119; Minshall, Brock, and Varley 1989, 707-714; Minshall, et al. 1995; Gresswell 1999, 193-215; Rieman, et al. 1997, 47-55; Rieman and Clayton 1997, 6-13).

Benthic macroinvertebrates, or bottom-dwelling aquatic insects, have been surveyed in the Elk Creek Watershed (USDA and USDI 1996). Overall, watershed and instream conditions at the sampling sites vary, and are reflected in the benthic community. The limited number of sample sites, however, does not allow for definite conclusions on the condition of the benthic community throughout the Elk Creek Watershed. More information is needed to detect the effects of fire on benthic aquatic insects (Lotspeich, et al. 1970, 221; Stefan 1977, 105). The abundance of macroinvertebrates in 5th and 6th order streams fluctuates, but species richness and

diversity remains unchanged. Macroinvertebrate communities generally have shown a range of effects dependent upon the fire severity and location of the burn in a watershed. Effects range from a shift in functional feeding groups and declines in species richness, to no changes in diversity (Gresswell 1999, 193, 208-215).

Macroinvertebrates vary with the amount of light penetration in the Riparian Reserve. Post-fire insect abundance can be high for several years and begins to increase the first year after the fire, possibly because nutrients are higher than before the fire. Consequently, streams experience more abundant insect communities. After the first year post-fire, fish populations can rebound to pre-fire levels or higher. Fish return or those that stayed have a higher survival rate and production. Higher nutrients, increased light, increase in algae, and more abundant food subsequently produce high fish survival and production. Post-fire insect density is usually stable and diversity decreases for several years (Minshall, Brock, and Varley 1989, 707-714; Minshall, et al. 1990, 111-119; Minshall 2003, 155-161; Rinne 1996, 653-657; Hawkins, Murphy, and Anderson 1982, 1840-1856; Li, et al. 1987, 193-202; Hawkins 1983, 1173-1185).

Generally, nutrient input from fire varies and is difficult to characterize because of different environmental variables such as magnitude, location of burn type, hillslope, and aspect (Beschta 1990, 219, 226, 227). Studies show nutrients, such as potassium, nitrogen, and phosphorous, occur as peak concentrations directly after a fire and are associated logically with precipitation (Brown, et al. 1973, 1450-1453; Albin 1979, 234). After the Yellowstone National Park fires in 1988, nutrients were not discernible in 5th and 6th order streams similar to West Branch Elk, Flat, and Sugarpine creeks (Gresswell 1999, 193-215).

3.5.2.2 Fish Passage

Pre-fire

Fish distribution is a major factor in fish production. The extent of a species range dictates the ability for sustained production. Connectivity of fish is important to maintain a viable reproducible population especially for access to food throughout the watershed. Connectivity is the connectedness or ability for fish to interact throughout the watershed. Fish naturally migrate to other drainages and maintain connectivity between fish populations in the watershed. Fish populations are very well connected throughout the Elk Creek Watershed. Unfragmented populations allow for viable salmon and trout populations.

Salmon and trout use Elk Creek and its tributaries for spawning and rearing. Spring and fall chinook salmon spawn in the lower reaches of Elk Creek when autumn flows increase enough to allow upstream migration. Coho and winter and summer steelhead migrate into tributaries to spawn. Coho generally spawn in lower gradient areas and steelhead spawn in higher gradient areas. Coho generally rear for one year in freshwater before migrating to the ocean, while steelhead rear from one to four years, with two years being the most common for Rogue River steelhead (Everest and Chapman 1972, 91, 99, 100).

Coho salmon inhabit West Branch, Alco, Jones, Flat, Sugarpine, and mainstem Elk creeks. Coho populations in the Elk Creek Watershed have gradually increased over the past decade due to the adult trap and haul facility below Elk Creek Dam. Elk Creek Dam is a partially-completed structure located near the mouth of Elk Creek. The dam allows partial passage to anadromous fish during certain flows. When flows limit passage at the tunnel in the dam site, coho are trapped and hauled above the dam.

Trout populations probably do not mix with the mainstem Rogue River populations and are isolated from the basin. Natural waterfalls are few and have isolated small areas for some trout populations. Four culverts on BLM-administered land allow only partial trout passage at certain stream flows and are only minor connectivity issues at the watershed scale (USDA and USDI 1996).

Fish populations can voluntarily emigrate from a fire area and effectively return rapidly to areas where there has been high burn severity. The fire and fish distribution and abundance is very small and localized compared to the Elk Creek Watershed and Upper Rogue Basin. A remnant fish population usually remains after a fire. This is likely to be the situation in this watershed. Stream connectivity is the major factor associated with fish population reestablishment (Gresswell 1999, 193-215; Hanski 1991; Rieman and McIntyre 1995, 285-295). Pre- and post-fire distribution connectivity is the same for salmon and trout adults and juveniles (Rieman, et al. 1997, 47-55).

3.5.2.3 Habitat

Habitat is a main factor in determining the salmon and trout carrying capacity of streams (Meehan 1991, 483-488). Habitat complexity in the Elk Creek Watershed is low and undesirable for optimal fish production. Sustained fish survival and production is primarily influenced by habitat complexity and amount of woody debris.

Historically, streams had a greater amount of woody debris. Fires and high fire frequency in the watershed would have been the primary mechanism for delivery of large wood to streams. Large wood improves channel stability and habitat complexity. Large woody debris (LWD) mediates winter survival of salmonids (Meehan 1991, 488-491, 504). Large woody debris is correlated with salmon and trout abundance (Bustard and Narver 1975, 681; Tschaplinski and Harman 1983, 452; Murphy, et al. 1986, 1521).

Instream Habitat

Pre-Fire

The Elk Creek Watershed is deficient in LWD and spawning gravel recruitment. Streams are high in cobble and bedrock substrate, which is less than desirable for juvenile fish rearing and is a limiting factor for spawning. It is speculated, based on historic stream conditions in western Oregon, a large percentage of cobble and bedrock were once covered with gravel and woody debris. The lack of pools and adequate pool depth as cover is another limiting factor in fish rearing.

Habitat complexity, at a minimum, is the combination of large woody debris, gravels, undercut banks, and pools for fish spawning and rearing and adult holding cover (Reeves, Everest, and Sedell 1993, 309, 314, 315; Bustard and Narver 1975, 684, 686; Tschaplinski and Hartman 1983, 452; Murphy, et al. 1986, 1526-1533; Hartman and Brown 1987, 262-270).

Habitat complexity in West Branch Elk, Flat, and Sugarpine creeks is lacking and less than desirable. Streambeds are degraded and need to be aggraded to more desired conditions to provide for more complex habitat to increase fish production. LWD increases stream channel stability and habitat complexity by providing stream bank stabilization and instream fish cover, and aiding in the collection of spawning gravels.

LWD is of major importance in building cover for instream fish habitat. Coho and trout production increases with increased LWD levels, especially when used as winter refugia for adults and juveniles (Boussu, et al. 1954, 229-239; Everest and Meehan 1981, 527, 529; Lister and Genoe 1979, 1219-1224; Osborn 1981, 76). Winter refugia are critical for salmon and trout survival. Juvenile coho seek cover in woody debris and move to smaller tributaries during floods. Coho seek side channels and slower waters during these events (Bustard and Narver 1975, 681; Bisson, et al. 1981, 70). Trout can endure faster waters than young coho salmon. Field observations and measurements indicate the major factors limiting salmon and trout production are winter refugia for juveniles and adult holding cover. Fish actively move throughout the Elk Creek Watershed with spring flows and in the autumn months when flows improve (Harmon, et al. 1986, 133-146; Murphy and Koski 1989, 427-436; Cederholm, et al. 1997, 947-963).

Streambeds in West Branch Elk, Flat, and Sugarpine creeks and tributaries are high in bedrock and cobble. This provides minimal habitat for fish rearing and spawning. Instream habitat has remained in overall poor condition in the Elk Creek Watershed over the last 30 years (see Appendix J, Fisheries).

Instream habitat is less than 20 percent gravel in Elk, West Branch Elk, Flat, Sugarpine, and Hawk creeks. A more desired condition would be a large portion of streams with spawning gravel. The desired habitat condition for pools is approximately 30 percent pools, rather than the 7 percent found in Hawk Creek, 11 percent in Sugarpine Creek, and 12 percent in Flat Creek.

Gravels and woody debris should be recruited over the bedrock and cobble streambed. The capture of gravels and woody debris would aggrade the streambed and allow flood waters to reconnect to the floodplain. This would allow nutrients to enter the riparian habitat and improve the connectivity between instream and riparian habitats.

Habitat restoration methods are effective for salmon and trout. Habitat restoration priorities in the Elk Creek Watershed include overwinter cover for adults and juveniles, summer food abundance, spawning habitat, and winter rearing habitat. Habitat restoration provides a definite method for increasing coho salmon smolt production and can produce a 100 percent increase in smolt production. Increasing population through habitat restoration is based on adequately identifying limiting factors for fish production. Overwinter survival can increase four-fold through habitat restoration.

Post-fire

Fires adjacent to larger streams such as Sugarpine, Flat, and West Branch Elk creeks, have less effect to fish populations than fires along smaller streams. The effects of fire on fish populations are less severe in larger streams. There is little evidence of negative effects on fish, stream habitat, and water chemistry. Gresswell (1999) depicted fish population abundance declined the first year after the 1988 Yellowstone National Park fires, yet remained in the range of natural variation. Fire can have varying levels of effect on the amount of large woody debris, sediment delivery and channel stability, substrate composition, water temperature, and instream and riparian cover.

Most streams with high burn severity in the fire area are void of large wood. However, large woody debris was added to streams with low to moderate burn severity from fire suppression efforts. Rehabilitation efforts contributed to LWD recruitment. Natural recruitment of large woody debris to the stream and riparian area after a fire occurs for many years during forest development. Fish habitat is enhanced and pools are created for fish rearing and cover (Swanson and Lienkaemper 1978, 1-11; Minshall, Brock, and Varley 1989, 707-714; Minshall, et al. 1990, 111-119; Gresswell 1999, 193-215). Large woody debris from debris torrents following a fire is beneficial for fish habitat and insect production in the short-term. Large wood added to streams from fire suppression efforts produces cover for fish and compliments channel complexity and substrate composition.

Generally stream channel structure is not affected much

from fire in the larger streams such as West Branch Elk, Flat and Sugarpine Creeks. Channel stability in severe burn areas could possibly change with increased stream flows and channel erosion. Substrate composition could also change with the addition of spawning gravel to the streams.

There is a possibility of a net loss of gravels the first five years from higher peak flows unless there are substantial debris torrents and other mass wasting events to supplement gravels and large woody debris. The Riparian Reserve would contribute to large woody debris, especially within the first 160 feet of the stream channel. Large amounts of fine sediment can degrade spawning and rearing habitat in the short-term (Reeves, et al. 1995; Gresswell 1999, 193-215). Sediment can indirectly affect aquatic insect production by covering stream substrate. Rinne (1996, 653-657) found insects declined to zero after a fire and recovered 25-30 percent 1 year later.

Biological consequences from elevated water temperature post-fire are difficult to predict because of the complexity of effects from burn severity, spatial pattern of the burn, stream size, stream network complexity, watershed topography, normal temperature ranges of affected stream reaches, and life history stage of the organisms present at the time of the fire. High water temperatures can adversely affect species abundance, diversity, egg incubation, and juvenile survival. Generally, changes in stream temperature are not directly lethal in 4th, 5th, and 6th order streams, such as West Branch Elk, Flat, and Sugarpine creeks. Studies from the Silver Fire show water temperatures increased 3 to 10° Celsius above normal in post-fire streams in southwest Oregon. These temperatures remained after one year in severely burned areas. However, downstream temperatures below these areas did not increase substantially after the Silver Fire (Amaranthus, et al. 1989, 75).

Riparian Habitat

Pre-fire

Riparian Reserves maintain and restore riparian structure and function of streams to benefit fish. After decades of timber harvest, Riparian Reserves in the Elk Creek Watershed have matured to hardwood and some conifer trees. West Branch Elk, Flat, and Sugarpine creeks had full reserves before the fire.

Habitat complexity and food abundance can mitigate inadequate or less desired riparian habitat (Bisson, Nielsen, and Ward 1988, 322-335). They can also mitigate high temperatures and high predation. Stream temperature is a result of water quality, quantity, and streamside shade. Elevated stream temperatures may stress fish but not kill them directly. Indirectly, the fish may be susceptible to disease and predation, especially with high prolonged temperatures. High food abundance can be a compensatory mechanism overriding cover and other environmental variables and varies seasonally. Riparian habitat has remained in overall good condition in the Elk Creek Watershed over the past 20 years.

Post-fire

West Branch Elk, Flat, and Sugarpine creeks are indicative of changes in riparian cover, large wood, and sediment influences to insect and fish abundance after a fire. Fire severity differs in burned watersheds and subsequently affects streams and riparian habitat differently. Fire causes an influx of nutrients for several years in the riparian habitat and to the streams. Soils are more exposed in different areas, increasing the probability of quicker surface water runoff and the potential for mass soil movement (Rieman and Clayton 1997, 6-15).

The greater burn severity resulted in a greater loss of shade in those riparian areas. Shade reduction can improve algae and insect production and subsequently fish production. Conversely, excessive shade reduction can increase water temperature and may have an indirect adverse effect to fish from an increase in disease and slower responses to predation.

Flat and Middle creeks were burned with greater severity and experienced greater changes to the riparian habitats than other watersheds with less severe burning.

Chronic Erosion

Pre-fire

Chronic erosion produces slow but continuous sediment deposition over a long time period primarily during moderate flows. Chronic erosion releases fine sediments which can be detrimental to fish eggs. Fine sediments may cover spawning gravels, especially in low velocity areas. Increased proportions of fine sediment in substrates have been associated with reduced intragravel survival of embryonic cutthroat trout and steelhead trout. Sediment can fill in rearing pools and limit the volume of water available for fish rearing. High velocity flows tend to rapidly carry most of the sediment out of the drainages. Fish population survival and production can decrease to a near remnant level from high chronic sediment input over the long-term. Nearly all streams in the Elk Creek Watershed have near remnant populations because of the simplified habitat (Bisson and Bilby 1982, 371-374).

Roads can be a principal contributor of sediment to fish-bearing streams. Rocked roads generally have a low to moderate risk of generating sediment from surface erosion. Natural surface roads have a high risk of generating sediment from surface erosion. The exact amount of sediment being delivered to stream channels from Federal roads within the Elk Creek Watershed is currently unknown.

Road crossings over streams provide an opportunity for excess sediment delivery to the stream. Road and stream-crossing fill have a moderate to high risk of failure when culverts plug during storm events, delivering sediment to the stream .

There are 243 miles of roads within riparian areas in the watershed. Approximately 170 miles of road are located within the Federal Riparian Reserve. Natural surface roads located within riparian areas would have a moderate to high risk of delivering sediment to streams. Generally, turbidity does not have a negative effect to aquatic resources. Turbidity in the Elk Creek Watershed is not seen as a major limiting factor for fish production or survival.

Post-fire

Chronic erosion from roads and check dams accelerates the first two years after a fire. In post-fire studies on the South Fork Salmon River in Idaho, 1 percent of sediment came from fire and 85 percent of sediment from roads (Brown and Krygier 1971, 1189-1198; Swanston 1991, 139-179; Gresswell 1999, 194-207). Check dams from fire rehabilitation efforts withhold sediment and have the potential to release sediment slowly. Sediment from check dams lingers and enters streams during high flows.

Ideally, the majority of sediment moves out of the system the first year during high flows with potential to improve habitat complexity. The rapid movement of sediment has more potential to deliver gravels to the stream than the slow trickling of sediment under moderate flows. The majority of erosion occurs within the first year with full recovery within 3-5 years. Total post-fire erosion usually ends after 10 years. Stream channels physical changes are common in the first four years after a fire (McNabb and Swanson 1990, 159-176; Gresswell 1999, 193-221).

Episodic Erosion

Pre-fire

Fish survival and production usually decreases in the first year after an episodic event. Short-term periodic high sediment levels are part of the natural variability within the natural fish life cycle. Environmental changes occur naturally and native fish adapt over the years to varying conditions (Gresswell 1999, 193-221; Bisson 1982, 371-384).

Post-Fire

Episodic events, such as mass wasting and debris torrents, can produce gravel recruitment for fish spawning beds and large woody debris for habitat complexity. The majority of episodic erosion and sediment movement occurs when high water velocities carry more than 70 percent of sediment downstream and distribute it throughout the river basin. Landslides, or mass wasting, and channel alteration are generally greatest in the first 10 years after a fire (Swanson 1981, 401-416; McNabb and Swanson 1990, 159-176; Gresswell 1999, 193-221).

Debris torrents can change a stream channel and produce stability to streambanks and can cause egg and alevin mortality from excessive sediment. Debris torrents containing large woody debris can stabilize streambanks. Large woody debris is a major factor in stream channel stability. Pulses of gravel and woody debris are delivered to a stream by debris flows and landslides. Short- and long-term results of episodic events after the first year after a fire can cause an increase in sediment, gravels, and woody debris. These events improve habitat complexity, introduce nutrients, and increase algae and insects. These events can also produce fish survival and production in the short-term, dependent on the timing of the event.

Erosion after fires is naturally high and contributes to long-term habitat complexity for fish spawning and rearing. The first winter after a fire, stream and road crossings have the potential to produce fish migration blockages at culverts. Post-fire observations show this is not a problem in the Timbered Rock Fire area. Post-fire debris torrents are likely to occur in tributaries to Hawk, Sugarpine, Flat, and West Branch Elk creeks.

The highest probability for episodic risks is from mid-slope road crossings which have a high potential for failure (Bisson, et al. in press, 70). Fish population survival and production usually increases from episodic events which increase sediment, gravels, and woody debris over the long-term. These events improve habitat complexity; introduce nutrients; and increase algae, insects, and fish survival and production in the short-term. Short-term periodic high sediment levels are part of the natural variability within the natural fish life cycle and cause short-term fish mortality.

Environmental changes occur naturally and native fish adapt over the years to varying conditions, increasing the probability of survival. Areas where fish are completely eliminated are reestablished within less than two years provided no significant habitat changes. Catastrophic events produce long-term habitat complexity (Gresswell 1999, 194-214).

3.5.3 Environmental Consequences

3.5.3.1 Effects Common to all Alternatives

Background

Salmon and trout have the ability to adapt to temporary harsh conditions and avoid undesirable situations. Many disturbances to fish are short-lived and tolerable. Many physical disturbances do not always cause an adverse biological effect. For example, episodic disturbances introduce gravel and wood to the stream to compliment habitat complexity and are a benefit to fish survival and

production. Fish populations start to recover within the first year from a fire disturbance (Dunham, et al. in press, 1-49; Rieman 1997, 47-55; Rieman and Clayton 1997, 6-13).

Determining the effect of a disturbance to fish populations is difficult because of the varied environmental factors which would affect fish populations. These factors along with disturbance factors have not been quantified in the scientific literature because of the expense and time required to conduct adequate monitoring.

Primary limiting factors for fish survival and production include lack of instream large woody debris, undersized culverts, chronic erosion from natural surface roads, and stream bank erosion. The lack of large wood is limited in the drainages within the Elk Creek Watershed, and causes a simplified stream channel and no cover for fish. Wood captures gravels for spawning and helps stabilize the stream banks and channel. The lack of wood produces channel instability and causes a long-term direct adverse effect to fish from the lack of cover. Habitat complexity, especially large woody debris (large trees) and woody material (small trees), is limited.

Chronic road erosion can cause fine sediment to reach the stream. It can reduce insect abundance by covering substrate with sediment. Consequently, the reduction in insects would reduce fish population abundance. The lack of food has an indirect adverse effect to fish production. The primary cause of fine sediment in spawning gravels is from stream bank erosion and redeposition of stream substrates.

Episodic erosion or mass wasting can produce sediment and cause an adverse effect to fish, similar to chronic effects. Episodic erosion delivers gravel and wood to streams, and provides a long-term beneficial effect to fish populations (Bisson and Bilby 1982, 371–373). Insect abundance dramatically increases because of the increase in sunlight to the stream when the riparian canopy is opened from fire or thinning practices. This is especially true in areas with gravels which provide surface area for insect production, unlike the Elk Creek Watershed. The increase in insect abundance can compensate for chronic erosion effects from sediment delivery to the stream. When fish food is abundant fish can tolerate poorer habitat conditions in summer months. Enhanced insect production can be achieved from riparian management of shade levels. Total stream cover may not always be desirable for insect production and diversity. Insect abundance can compensate for low amounts of wood during summer months and the opposite in winter months (Rieman and Clayton 1997, 6-13; Murphy and Hall 1981, 469-478; Murphy, et al. 1986, 1521-1533).

Fish require cover more in the winter to avoid high flows and expend less energy, than they require food. These relationships underscore the importance of large woody debris and small woody material in a stream. Wood is needed to stabilize stream banks to reduce erosion, and provide cover for fish, especially during the winter.

Salvage

Direct and Indirect Effects

Hazard tree removal alongside roads would create small channels from dragging trees to the road. All channels would be water-barred and road cut-banks restored to original slopes. Negligible sediment would reach the streams with this project design feature. Roadside hazard trees in Riparian Reserves or owl activity centers would be cut and remain on-site for fish habitat enhancement causing a long-term beneficial direct effect to fish.

Area salvage in all alternatives follows similar project design features for each method of harvest. Harvest project design features include maintaining Riparian Reserves and no commercial harvest in the Riparian Reserves, except in Alternative G. Riparian Reserves would be, at a minimum, 160 feet on each side of intermittent and perennial streams and 320 feet on each side of fish-bearing streams. The effects from water temperatures and surface sediment would remain the same as Alternative A. The burn area Riparian Reserves would continue to provide shade and moderate increases in water temperature (Rieman and Clayton 1997, 9; Murphy and Koski 1989, 427-436).

There are no harvest acres proposed in Alternatives A and B. Proposed harvest acres are low in Alternatives C and F, moderate in Alternative D, and highest in Alternatives E and G. Overall, the harvest methods and project design features minimize adverse effects to fish.

Riparian Reserves would mitigate short- or long-term adverse effects of harvest in all alternatives. The negligible risk of sediment reaching the stream would have no short- or long-term direct or indirect adverse effect to fish or fish population survival and production.

Sediment from road use related to harvest activities would cause a negligible direct short-term adverse effect to insect abundance. A decrease in insect abundance would possibly cause a negligible indirect short-term adverse effect to fish. Stream flows would be higher to flush sediment out of the watershed. Salmon and trout are very adapted to changing stream conditions and would move throughout the drainage to find food. The road use would have minimal adverse effects to fish population survival or production if the natural surface roads are surfaced or decommissioned.

Long-term harvest studies have shown negligible effects to fish populations from harvest with stream buffers (Meehan 1991, 750; Hall and Lantz 1969, 355; Holtby 1988, 502-514). The same effect would occur in any action alternative with harvest. Trout and salmon survival and production would remain unchanged and within the range of natural

variability in the watershed. Harvest would not cause short- or long-term adverse indirect or direct effects to fish population survival or production.

Long-term harvest research indicates:

- Major effects to fish mostly involve clearcut areas without Riparian Reserves.
- Past logging refers to: (1) clearcut areas without Riparian Reserves and with equipment in the streams, and (2) no large woody debris or rock weirs used to capture gravel and other wood for complex habitat to increase survival and production in the short-term.
- Sediment dramatically decreased the first year after logging clearcuts.
- Chronic erosion would not be a major problem with adequate habitat complexity.

Restoration

Direct and Indirect Effects

All action alternatives present a conservative approach to restoring watershed processes and avoiding sensitive areas, such as potential mass wasting sites. Restoration projects have direct and indirect beneficial effects to the survival and production of fish. The level of restoration is proportional with the level of minimizing adverse effects and enhancing fish production and survival. Generally, restoration projects would be implemented over a period of several years at different magnitudes. Typically, fish populations improve with more watershed restoration.

Alternatives with a low level of restoration effort would have lower beneficial effects than moderate or high levels of restoration. The level of survival and production for salmon and trout would increase with an increase in restoration. Alternatives B, C, D, and E include restoration efforts to improve fish populations more quickly (see Figure 3.5-2). Restoration projects with no effect on aquatic life include eagle habitat restoration, denning habitat, pine release, and oak woodland restoration. Additionally, these projects would be located outside the first site-potential tree, except oak woodland restoration.

Restoration projects, other than those mentioned above, have short-term adverse and long-term beneficial effects to aquatic life. Restoration projects which would benefit fish include riparian thinning, fuel treatments, and fish habitat improvement.

Pump chance reconstruction could produce a negligible amount of sediment to the stream. Project design features would prevent most sediment from entering the stream. Any sediment from pump chance reconstruction would have a less than negligible effect to fish.

Riparian Reserve thinning and fish habitat improvement projects would add large and small trees to the stream for fish habitat. Fuel treatments would reduce fuel loading and the risk of wildfire, and potential loss of riparian habitat. These activities would provide long-term benefits to fish population survival and production. Fish populations would remain above the remnant level within the range of natural variability.

Fish passage improvements would provide an immediate long-term benefit to fish populations. Currently, four culverts either impede or stop trout migration. These culverts would be replaced in all action alternatives. Undersized culverts cause partial or total passage of trout in a few drainages. Trout populations have a minor amount of fragmentation in the watershed, despite the blockages. The improvement of fish passage would have an immediate direct long-term beneficial effect by increasing habitat availability and trout production.

Road fords at Sugarpine, Hawk, and Timber creeks would have gates installed to minimize traffic. A temporary culvert would be placed in Timber Creek during timber harvest. Spawning-size gravel would be used over the culvert and would remain in the stream for trout use after the culvert is pulled out. This would cause a long-term beneficial direct effect to trout.

Cumulative Effects

Non-point sources of sediment from natural and unnatural causes are usually indistinguishable. The exact effect of sediment to salmon and trout would be difficult to determine because of their innate ability to adapt to varying sediment conditions, and the variability of environmental factors which have a large effect on a fish population. Very high levels of sediment from natural surface roads or streambank erosion can potentially limit insect production and suffocate fish eggs. Direct effects of sediment to fish are unlikely, and were more likely to occur in past decades when streams were heavily laden with fine sediment from past forest practices. Only a small part of chronic erosion actually causes indirect mortality to fish (Everest 1987, 133).

The Boise Cascade Watershed Analysis describes no adverse effect to aquatic life from pre-fire levels of sediment deposited to the streams. Swanson (1981) depicts more than 70 percent of long-term sediment yield occurs during and immediately after a fire. Stream channel physical changes are common in the first four years after a fire (Minshall, Brock, and Varley 1989, 707-714). Post-fire road activities usually deposit the most sediment into streams during the first and second year. Project design features and road restoration activities would minimize adverse effects to maintain salmon and trout population viability. This would occur in the short- and long-term throughout the watershed.

The partially completed Elk Creek Dam isolates trout

populations from the Rogue River, yet not enough to affect trout survival and production. Trout abundance is maintained within the Elk Creek Watershed, and adult anadromous fish are transported around the dam. It is unknown how often trout and anadromous fish migrated back and forth from the Rogue River prior to construction of the dam. Typically, trout can move throughout a watershed within miles of their birthplace. Coho salmon yearlings do not move as much as a yearling trout, chinook, or steelhead.

The Timbered Rock Fire burned in a mosaic pattern in severity and intensity and caused a patchy effect to fish populations in the drainages. Streams and Riparian Reserves were affected by different degrees of burn severity. The extent of the effect of the burn on fish varies from one small patch to another. Overall, fish had opportunity to escape to other safer stream conditions if needed. Most streams were not adversely affected by the fire to produce a direct or indirect mortality which would result in a decrease in fish survival or production. Fish population viability remains in the range of natural variability (Minshall, Robinson, and Lawrence 1997, 2509-2525).

Ammonium-based fire retardants are a fertilizer used in fire suppression. There are few reports documenting fish mortality from retardant yet it is acknowledged to have the ability to cause direct and indirect mortality. Direct mortality is believed to have a low occurrence or is non-existent in most cases. Retardant is most often applied directly to the hillsides and not over a stream. Any retardant applied over a stream is usually applied at an angle to the stream which minimizes the risk of direct exposure and mortality to fish.

Research shows retardant applied on hillsides dissipates in the soil before it reaches a stream. The retardant quickly acts as a fertilizer and dissipates in a few days to the point of having a beneficial effect to the watershed. Field and laboratory research indicates fish and aquatic insect mortality can occur if they are at the drop center. Laboratory studies have been performed to determine the lethal and sub-lethal effects to fish. Additional field research is needed to determine retardant effects to fish. No adverse effects to fish are anticipated from retardant use during the Timbered Rock Fire. The dispersion of 38,818 gallons occurred near the ridge tops at the near origin of the fire. Retardant dissipated to provide a beneficial effect by fertilizing the hillside with potential beneficial effect to the aquatic resources after the first few years (Van Meter and Hardy 1971, 1-16; Norris and Webb 1988, 12-26; Meehan 1991).

The intensity and duration of any adverse effects from the fire would depend upon the severity and location of the burn. Subyearling fish mortality would be potentially higher than yearling mortality because they are less mobile in the watershed. Fire opens the riparian canopy and allows more light on the stream. The increase in light would enhance primary production and insect abundance dramatically (Gresswell 1999, 193-215). The abundant insects cause an increase in coho and trout growth. Coho grow larger sooner and migrate earlier to the ocean, which increases coho survival. Yearlings and adults have the ability to move out of the system and into the other connected streams for refuge.

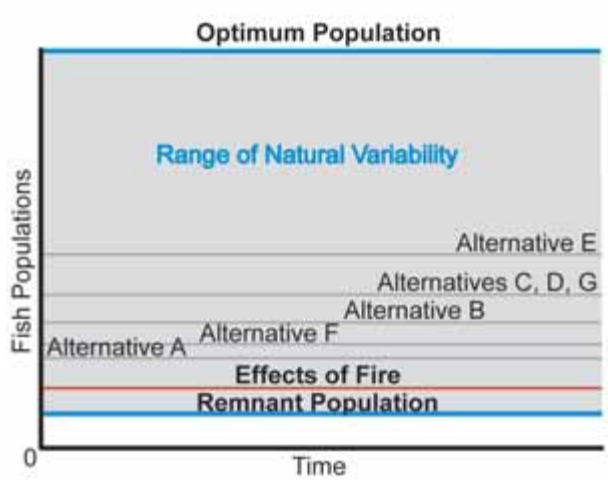
Fish may emigrate from the area and return months later to repopulate. Effects would be inconsequential because of the mosaic burn and mosaic effect to the fish populations. Juvenile fish and spawning adults have been seen in the major drainages after the fire. Short-term adverse effects in the severe burn areas would slightly decrease survival and production of fish populations. Effects can be exacerbated with post-fire human activities, such as check dams in draws which contribute to chronic erosion. Rehabilitation effects are localized, with minimal to inconsequential effects to the watershed fish population. Effects are similar in all drainages.

The long-term benefit of fire to fish populations would be the sizeable increase in nutrients and wood to the stream. This substantially enhances insect growth and fish abundance.

The effects of harvest-associated road activities on private lands could cause a long-term direct effect or decrease in insect abundance from sediment deposited in the streams, and a short-term indirect adverse effect to fish. The long-term effect is from the lack of mitigation for road effects from private lands.

The cumulative effects of the proposed harvest would be inconsequential when compared to the effects of the fire, the effects of culvert replacement, and the effects of harvest and road use on private lands. Harvest on private lands includes minimal buffers and equipment operating next to intermittent stream banks. Mass wasting from road failures has resulted in some areas. Sediment from natural surface roads can be one of the major limiting factors for fish survival and production. The long-term effects of the fire are greater than any alternative (see Figure 3.5-2).

Figure 3.5-2. Comparative Effects of the Fire and Alternatives on Fish Population



The effect of herbicide application on private lands would be negligible to fish. Standard application procedures would minimize herbicides in the stream and there would be no direct application to streams. Fish population survival and production would remain within the range of natural variability from cumulative effects within the watershed. The cumulative effects from salvage on private and Federal lands would maintain fish populations in the range of natural variability when considering past, present and reasonably foreseeable future actions.

Overall, the long-term benefit of the proposed restoration projects in the LSR would enhance instream habitat complexity and fish survival and production. Promoting larger tree growth would accelerate trees naturally falling into the streams. Increasing large wood in the long-term would dramatically help overcome this primary limiting factor in fish population survival and production. The fish populations remain viable and in the range of natural variability regardless of adverse affects from harvest, road, or restoration activities

3.5.3.2 Populations and Habitat

Effects of Alternative A (No Action) on Populations and Habitat

- Alternative A maintains a delay for watershed improvements. Alternative A ignores the need for improvement of road erosion, fish passage and habitat complexity. Road work, habitat enhancement, culvert improvement, or riparian thinning would not occur.
- This alternative lacks any beneficial effects to trout and salmon survival and production.
- The intensity and duration of cumulative effects in the watershed result in no improvement to fish population survival and production which remains near a remnant level within the range of natural variability.

The following effects are the same in all drainages within the Elk Creek Watershed.

Direct and Indirect Effects

Trout and salmon population trends would remain low within the range of natural variability without the addition large wood to the stream or minimizing soil erosion from roads.

Chronic erosion from natural surface roads is of high concern and from gravel roads is a moderate concern. The main concern with gravel roads is not during normal road use but the season after high road use associated with timber harvest. Chronic erosion, especially from natural surface and gravel roads, would potentially cause a direct long-term adverse effect and decrease the insect abundance from the erosion of fine sediment into the streams. Sediment could cover insect habitat and produce an indirect long-term adverse effect to trout and salmon abundance from a decrease in insect abundance.

Large pooling of sediment behind upland culverts on intermittent streams is a concern and can cause chronic erosion and have the same effect on fish. The lack of implementation of road projects would maintain trout and salmon population trends at a low or modest level.

Mass wasting from potential road failures would not be ameliorated in Alternative A. Episodic erosion events would continue to add sediment to the stream and could cause an indirect and direct adverse short-term effect to fish. It would also cause deposition of woody material and gravel recruitment for fish spawning and rearing. Continued chronic and episodic erosion would maintain the poor trout and salmon population trends with poor survival and production.

Fish passage is a major limiting factor for fish production. Currently, four culverts either impede or stop trout migration to five miles of habitat. The long-term direct adverse effect is the lost opportunity to increase trout production.
Large woody debris and smaller woody material are major limiting factors for fish survival and production. The instream habitat condition would remain poor without addition of rock weirs, gravel, or logs. Several logs have provided some large woody debris from the fire; however trout and salmon survival and production would remain low because of the poor habitat complexity. Habitat complexity, which includes gravels and woody material, relates directly to fish survival and production. This alternative would continue the lack of gravel and woody material required for egg and fry development and rearing. The lack of large wood would continue stream channel instability and cause an indirect adverse effect.

Stream banks would continue to erode at higher than historically normal rates compared to stream systems with abundant wood. The lack of large wood would not allow for an accumulation of woody material for fish cover. The lack of cover during winter months is a critical limiting factor for fish survival and production. The lack of gravel and wood would continue to maintain the poor trout and salmon population trends with poor survival and production in the long-term. This would cause a long-term direct adverse effect to fish populations.

Thinning trees in the riparian reserve would not occur in Alternative A. Competition between small and large trees would continue to inhibit growth of large trees and slow the rate of trees falling into the stream for fish habitat. Additionally, there is a lost opportunity for trees to be pulled into the stream for fish habitat improvement. Cover is a major limiting factor for fish survival and production. The lack of additional instream wood would have an indirect and

direct adverse effect to fish abundance. Fish survival and production would not increase in the short- and long-term.

The lack of road improvements would continue to cause indirect long-term adverse effects to fish populations, yet would maintain a remnant population. There is no long-term direct benefit to trout or federally-listed threatened coho salmon because of the lost opportunity for road work, habitat enhancement, culvert improvement, or riparian thinning. Coho salmon and trout population trends would remain low but within the range of natural variability in the watershed.

Cumulative Effects

The fire effects common to all alternatives discussion applies to Alternative A. The intensity and duration of the fire effect maintains the fish population at a near remnant level. The Timbered Rock Fire burned in a mosaic pattern in severity and intensity and caused a mixture of effects to fish populations. The effects to fish are inconsequential because the short-term adverse effects in the severe burn areas may slightly decrease survival and production of fish populations by limiting insect abundance. Fish populations remain in the range of natural variability.

Alternative A includes natural stream improvement over a very long time period. Disturbances like fire: (1) add wood to the stream; and (2) open the riparian canopy to more sunlight, providing a direct long-term beneficial effect of improving insect abundance and fish production. Natural erosion effects would minimally decrease insect and fish abundance.

Trout and salmon population trends would remain on the low end of the range of natural variability without efforts to reduce soil erosion from roads. The intensity of chronic erosion from natural surface roads is a high concern. Delivery of fine sediments from gravel surface roads is a moderate concern for producing adverse long-term indirect effects to fish. Instream habitat condition is poor in the Elk Creek Watershed and the near remnant fish population survives despite the present chronic erosion and sediment yields from roads. Fish production and survival would remain low from the lack of instream wood, chronic sediment from natural surface roads, and large pooling of sediment from upland intermittent stream culverts. The result is a long-term adverse direct effect to insect abundance and indirect long-term adverse effect to fish (Benda, et al. 2003, 105-119).

Populations typically rebound in the short-term from disturbances and effects are anticipated to be the same across drainages. Near remnant trout and salmon population survival and production would remain unchanged and within the range of natural variability (Minshall 2003, 155-161).

Harvest and road activities on private lands would cause a long-term direct effect or decrease in insect abundance from sediment deposited in the streams, and a short-term indirect adverse effect to fish populations. The long-term effect is from the lack of road decommissioning on private lands. The effect of fire severity is the same for private and Federal lands. The effect of herbicide application on industrial forest lands would be negligible to fish. Standard application procedures would minimize herbicides in the stream and no direct application to streams occurs. Anticipated effects to fish population survival or production would not be outside the range of natural variability.

Effects of Alternative B on Populations and Habitat

- Alternative B greatly reduces road erosion primarily from replacing high risk mid-slope culverts. This would improve fish passage and habitat complexity and has indirect short- and long-term beneficial effects to trout and salmon survival and production.
- Watershed improvements would modestly increase fish abundance, yet above a remnant population and within the range of natural variability.
- The intensity and duration of cumulative effects in the watershed would result in a modest improvement in fish population survival and production which remains near a remnant level within the range of natural variability.

The following effects are the same in all drainages within the Elk Creek Watershed.

Direct and Indirect Effects

Alternative B includes a low level of restoration and includes 2.6 miles of road reconstruction, 15 road cross-drain culvert sites for mid-slope road improvements, 100 miles of road maintenance, and 35 miles of decommissioning. Road density would decrease a small amount.

Large pooling of sediment behind upland culverts on intermittent streams is a concern and can cause chronic erosion. The lack of implementation of road projects would maintain chronic erosion levels.

Mass wasting from potential road failures and associated debris torrents would be minimally reduced in Alternative B at 15 sites. Mid-slope culverts on intermittent streams with road fills have the largest potential for episodic erosion. The potential for these episodic erosion events would continue to add sediment to the stream and cause a short-term indirect and direct adverse effect to fish from the addition of sediment. It could cause a long-term beneficial direct effect from gravel recruitment and addition of woody material and could cause enhanced fish spawning and rearing.

The low level of road improvements in Alternative B would continue to allow chronic and episodic erosion and have a modest long-term indirect adverse effect to trout and salmon survival and production.

Alternative B includes a modest level of fish habitat improvement with three rock weirs and 15 logs per mile, and a high level with gravel placement. Weirs would collect spawning gravels and develop plunge pools and provide rearing habitat for juvenile fish. The improvement of instream habitat complexity with weirs and large woody debris would modestly improve trout and salmon survival and production.

The result of the habitat enhancement would be a short- and long-term benefit to trout and federally-listed threatened Coho salmon. Coho salmon and trout population trends would remain low but within the range of natural variability in the watershed.

Thinning 117 acres of trees in the Riparian Reserve in Alternative B would reduce competition between small and large trees. This would allow larger trees to grow faster and fall into the stream for fish habitat sooner than a natural occurrence. Additionally, small diameter trees and large trees would be pulled into the stream as woody material for improvement of fish habitat complexity. Thinning would contribute a short- and long-term direct and indirect beneficial effect to fish from improved tree stand condition, and increased insect and fish abundance. The large woody debris and small diameter woody material would provide cover and an immediate benefit to survival and production.

The combined Riparian Reserves, instream, riparian, and road restoration projects would cause a long-term beneficial indirect and direct effect to fish population survival and production. Trout and salmon population trends would modestly increase in Alternative B. Overall, population survival and production would remain low primarily from the lack of instream wood. The aquatic condition in the watershed would provide a continued long-term adverse effect to insect and fish abundance. Trout and salmon abundance would remain at or above a remnant level yet within the range of natural variability.

Cumulative Effects

Trout and salmon population trends would modestly improve with the effort to minimize sediment erosion from roads, but would remain at a near remnant population level.

The intensity of chronic erosion is a high concern from natural surfaced roads, and a moderate concern from gravel surface roads. Chronic erosion of fine sediment would continue to moderately decrease insect and fish abundance from natural surface roads and pool sediment behind upland culverts on intermittent streams. Road density would remain high, primarily from the large number of non-Federal roads. Road densities on average would not change more than 0.5 miles per square mile for this alternative and all others.

Episodic erosion would provide gravel and wood to streams and when combined with culvert improvements, would cause a modest increase in fish population survival and production.

Episodic erosion also causes sediment deposited to streams. Populations typically rebound in the short-term from chronic and episodic disturbances. The addition of large wood and small woody material would help improve the lack of instream wood (Minshall 2003, 155-161).

The effects of harvest and road activities on industrial forest lands would cause a long-term direct effect by decreasing insect abundance from sediment deposited in the streams, and a short-term indirect adverse effect to fish populations. The long-term effect would occur from the lack of road decommissioning on private lands. The effect of fire severity is the same for private and Federal lands. The effect of herbicide application on industrial forest lands would be negligible to fish. Standard application procedures would minimize herbicides in the stream and no direct application to streams would occur. There are no anticipated effects to fish population survival or production which are outside the range of natural variability.

The following is a determination of effects for Southern Oregon/California (SONC) threatened coho salmon, SONC critical habitat, and Essential Fish Habitat (EFH) in regard to implementation of Alternative B. The result of restoration activities would be a “May Affect, Not Likely to Adversely Affect” determination due to an anticipated more than negligible effect from sediment disturbance to insect habitat and abundance. This slight possibility may indirectly effect the growth of an individual fish. Restoration activities would cause a short-term adverse effect and a long-term beneficial effect to an individual. Any effects would be minimized by the project design features.

Effects of Alternatives C and D on Populations and Habitat

- Alternatives C and D would moderately reduce and improve road erosion, fish passage and habitat complexity, and would have indirect short- and long-term beneficial effects to trout and salmon survival and production.
- Watershed improvements would moderately increase fish abundance above a remnant population and within the range of natural variability.
- The intensity and duration of cumulative effects result in a modest improvement in fish population survival and production which remains above a remnant level within the range of natural variability.

The following effects are the same in all drainages within the Elk Creek Watershed.

Direct and Indirect Effects

Alternatives C and D include a moderate level of restoration

and 2.6 miles of road reconstruction, 11 stream-crossing culvert sites for mid-slope road improvements, 100 miles of road maintenance, and 35 miles of decommissioning. Temporary road construction for Alternatives C and D would consist of .25 and .6 miles respectively and would be limited to very short spur roads on ridge tops. Road density would decrease a small amount.

Large pooling of sediment behind upland culverts on intermittent streams is a concern and can cause chronic erosion. Implementation of road projects would decrease chronic erosion by up to 46 percent (Boise 1999).

Mass wasting from potential road failures would be minimally reduced in Alternatives C and D at 11 sites. Mid-slope culverts on intermittent streams with road fills have the largest potential for episodic erosion. Episodic erosion events would continue to add sediment to the stream, and cause a short-term indirect and direct adverse effect to fish from the addition of sediment. It would cause a long-term beneficial direct effect from gravel recruitment and addition of woody material and would cause enhanced fish spawning and rearing.

The moderate level of road improvements in Alternatives C and D would reduce the level of chronic and episodic erosion and have a modest long-term indirect beneficial effect to trout and salmon survival and production. Fish population survival and production would remain in the range of natural variability.

Alternatives C and D include a modest level of fish habitat improvement with five rock weirs and 20 logs per mile, and a high level with gravel placement. Weirs would collect spawning gravels and develop plunge pools and provide rearing habitat for juvenile fish. The improvement of instream habitat complexity with weirs and large woody debris would modestly improve trout and salmon survival and production.

The result of the improvements is a short- and long-term benefit to trout and federally-listed threatened coho salmon from the habitat enhancement. Coho salmon and trout population trends would remain low but within the range of natural variability in the watershed.

Thinning 359 acres of trees in the riparian reserve in alternatives C and D reduces competition between small and large trees would be minimized and allow larger trees to grow faster and fall into the stream for fish habitat sooner than a natural occurrence. Additionally, small diameter trees and large trees would be pulled into the stream as woody material for improvement of fish habitat complexity. Thinning would contribute a short and long term direct and indirect beneficial effect to fish from improved tree stand condition, and increased insect and fish abundance. The large woody debris and small diameter woody material provides cover and an immediate benefit, improving survival and production.

Alternatives C and D moderately improve road erosion and habitat complexity, yet enhance fish passage. They would have indirect short- and long-term beneficial effects to trout and salmon survival and production. Watershed improvements would more than modestly improve fish population trends yet maintain a population within the range of natural variability.

The combined Riparian Reserves and instream, riparian, and road restoration plans would cause a long-term beneficial effect to fish population survival and production. Trout and salmon population trends would modestly increase in Alternative C and D. Overall, population survival and production would improve modestly from the addition of instream wood. The aquatic condition in the watershed is a continued long-term adverse effect to insect and fish abundance. Trout and salmon populations would remain at or above a remnant level yet within the range of natural variability.

Cumulative Effects

Implementation of road projects would decrease chronic erosion up to 46 percent (Boise 1999).

Chronic erosion is of high concern from natural surface roads and a moderate concern from gravel roads, especially after high road use associated with heavy truck traffic. Chronic erosion from natural surface and gravel roads potentially causes a long-term adverse effect and decreases the insect abundance from fine sediment eroding to the streams. Sediment can cover insect habitat and can produce an indirect long term adverse effect to trout and salmon abundance from a decrease in insect abundance.

Road density would remain high, primarily from the large number of non-Federal roads. Road densities on the average would not change more than 0.5 miles per square mile for this alternative and all others. Episodic erosion would provide gravel and wood to streams. Culvert improvements would cause a modest increase in fish population survival and production. Episodic erosion would cause additional sediment to streams and have similar effects as chronic erosion. Populations typically rebound in the short term from chronic and episodic disturbances. The addition of large wood and small woody material will help ameliorate the lack of instream wood (Minshall 2003, 155-161).

The effects of harvest and road activities on private lands would cause a long-term direct effect or decrease in insect abundance from sediment deposited in the streams, and a short term indirect adverse effect to fish populations. The long term effect is from the lack of road decommissioning on private lands. The effect of fire severity is the same for private and Federal lands. The effect of herbicide application

on private lands would be negligible to fish. Standard application procedures would minimize herbicides in the stream and there is no direct application to streams. There are no anticipated effects to fish population survival or production which are outside the range of natural variability.

The following is a determination of effects for Southern Oregon/California (SONC) threatened Coho Salmon, SONC critical habitat, and Essential Fish Habitat (EFH) in regard to implementation of Alternatives C and D. The result of salvage activities would be a "May Affect, Not Likely to Adversely Affect" determination, because of negligible effects anticipated from salvage. The result of restoration activities are a "May Affect, Not Likely to Adversely Affect" determination because of an anticipated more than negligible effect from sediment disturbance to insect habitat and abundance. This slight possibility may indirectly effect the growth of an individual fish. Restoration activities would cause a short-term adverse effect and a long-term beneficial effect to an individual. Any effects would be minimized by project design features.

Effects of Alternative E on Populations and Habitat

- Alternative E would greatly reduce and improve road erosion, fish passage and habitat complexity and has indirect short- and long-term beneficial effects to trout and salmon survival and production.
- Watershed improvements would substantially increase fish abundance, yet above a remnant population and within the range of natural variability.
- The intensity and duration of cumulative effects results in a large improvement in fish population survival and production and remains above a remnant level within the range of natural variability.

The following effects are the same in all drainages within the Elk Creek Watershed.

Direct and Indirect Effects

Alternative E includes an extensive level of road restoration work and includes 2.6 miles of road reconstruction, 26 stream-crossing culvert sites for mid-slope road improvements, 115 miles of road maintenance, and 43 miles of decommissioning. Temporary road construction would consist of 1.5 miles of short spur roads on ridge tops. Road density would decrease a small amount.

Large pooling of sediment behind upland culverts on intermittent streams is a concern and can cause chronic erosion. Implementation of road projects would decrease chronic erosion up to 46 percent (Boise 1999).

Mass wasting from potential road failures would be greatly reduced in Alternative E at 26 sites. Mid-slope culverts on intermittent streams with road fills have the largest potential for episodic erosion. These episodic erosion events would continue to add sediment to the stream, and cause a short-term indirect and direct adverse effect to fish from the addition of sediment. It would cause a long-term beneficial direct effect from gravel recruitment and addition of woody material and would cause enhanced fish spawning and rearing.

The high level of road improvements in Alternative E would greatly improve chronic and episodic erosion and have a substantial long-term indirect beneficial effect to trout and salmon survival and production.

Alternative E includes the highest level of fish habitat improvement with installation of 10 rock weirs and 25 logs per mile, and placement of gravel. Weirs would collect spawning gravels, develop plunge pools, and provide rearing habitat for juvenile fish. The improvement of instream habitat complexity with weirs and large woody debris would modestly improve trout and salmon survival and production.

The result of the improvements is a short- and long-term benefit to trout and Federally-listed threatened coho salmon from the habitat enhancement. Coho salmon and trout population trends would increase from low to moderate but within the range of natural variability in the watershed.

Thinning 1,050 acres of trees in the Riparian Reserve in Alternative E would reduce competition between small and large trees. Larger trees would be allowed to grow faster and fall into the stream for fish habitat sooner than a natural occurrence. Additionally, small diameter trees and large trees would be pulled into the stream as woody material for improvement of fish habitat complexity. Thinning would contribute a short- and long-term direct and indirect beneficial effect to fish from improved tree stand condition, and increased insect and fish abundance. The large woody debris and small diameter woody material provides cover and an immediate benefit, improving survival and production.

Alternative E provides an extensive effort to reduce road erosion, and improve habitat complexity and fish passage. The efforts would have indirect short- and long-term beneficial effects to trout and salmon survival and production. Watershed improvements would be an ambitious improvement to fish population trends yet maintain a population within the range of natural variability.

The combined full Riparian Reserves, and instream, riparian and road restoration plans would cause a long-term beneficial indirect and direct effect to fish population survival and production. Trout and salmon population trends would greatly increase in Alternative E. Overall, population survival and production would improve substantially from the addition of instream wood. The aquatic condition in the

watershed is a continued long-term adverse effect to insect and fish abundance. Trout and salmon populations would remain at or above a remnant level yet within the range of natural variability.

Cumulative Effects

Implementation of road projects would decrease chronic erosion up to 46 percent (Boise 1999).

The intensity of chronic erosion from natural surfaced roads is a high concern, and gravel surface roads are a moderate concern. Chronic erosion of fine sediment from natural surface roads and the large pooling of sediment behind upland culverts on intermittent streams would continue to moderately decrease insect and fish abundance.

Road density would remain high, primarily from the large number of non-Federal roads. Road densities on the average would not change more than 0.5 miles per square mile under this alternative and all others.

Episodic erosion would provide gravel and wood to streams and would cause a modest increase in fish population survival and production. Episodic erosion would cause additional sediment to streams and have similar effects as chronic erosion. Populations typically rebound in the short-term from chronic and episodic disturbances. The addition of large wood and small woody material would compensate for the lack of instream wood (Minshall 2003, 155-161).

The effects of harvest and road activities on private lands would cause a long-term direct effect or decrease in insect abundance from sediment deposited in the streams, and a short-term indirect adverse effect to fish populations. The long-term effect is from the lack of road decommissioning on private lands. The effect of herbicide application on private lands would be negligible to fish. Standard application procedures would minimize herbicides in the stream and no direct application to streams would occur. There are no anticipated effects to fish population survival or production which are outside the range of natural variability.

The following is a determination of effects for Southern Oregon/California (SONC) threatened Coho Salmon, SONC critical habitat, and Essential Fish Habitat (EFH) from implementation of Alternative E. The result of salvage activities would be a “May Affect, Not Likely to Adversely Affect” determination, because of negligible effects anticipated from salvage. The result of restoration activities are a “May Affect, Not Likely to Adversely Affect” determination because of an anticipated more than negligible effect from sediment disturbance to insect habitat and abundance. This slight possibility may indirectly affect the growth of an individual fish. Restoration activities would cause a short-term adverse effect and a long-term beneficial effect to an individual. Any effects would be minimized by the project design features.

Effects of Alternative F on Populations and Habitat

- Alternative F moderately decreases road erosion, substantially improves fish passage and habitat complexity, and has short- and long-term beneficial effects to trout and salmon survival and production.
- Watershed improvements would modestly improve fish population trends yet maintain a remnant population within the range of natural variability.
- The intensity and duration of cumulative effects result in a modest improvement in fish population survival and production which remains near a remnant level within the range of natural variability.

The following effects are the same in all drainages within the Elk Creek Watershed.

Direct and Indirect Effects

Alternative F includes a moderate level of restoration and includes 2.6 miles of road reconstruction, 26 stream-crossing culvert sites for mid-slope road improvements, 68 miles of road maintenance, and 17 miles of decommissioning. There would be no road construction and road density would decrease a small amount.

Large pooling of sediment behind upland culverts on intermittent streams is a concern and can cause chronic erosion. Implementation of road projects would decrease chronic erosion by up to 46 percent (Boise 1999).

Mass wasting from potential road failures would be minimally reduced in Alternative E at 26 sites. Mid-slope culverts on intermittent streams with road fills have the largest potential for episodic erosion. The potential for these episodic erosion events would continue to add sediment to the stream, and cause a short-term indirect and direct adverse effect to fish from the addition of sediment. It would cause a long-term beneficial direct effect from gravel recruitment and the addition of woody material, and would cause enhanced fish spawning and rearing.

The moderate level of road improvements in Alternative F would modestly improve chronic and episodic erosion and have a substantial long-term indirect beneficial effect to trout and salmon population survival and production.

Alternative F includes a low level of fish habitat improvement projects with installation of 3 rock weirs per mile and a high level with gravel placement and installation of 25 logs per mile. Weirs would collect spawning gravels, develop plunge pools, and provide rearing habitat for juvenile fish. The improvement of instream habitat complexity with weirs and large woody debris would modestly improve trout and salmon survival and production.

The result of the habitat enhancement would be a short- and long-term benefit to trout and federally-listed threatened coho salmon. Coho salmon and trout population trends would remain low but within the range of natural variability in the watershed.

Thinning trees in the Riparian Reserve would not occur in Alternative F. Competition between small and large trees would continue to inhibit growth of large trees and slow the rate of trees falling into the stream for fish habitat. Additionally, there would be a lost opportunity for trees to be pulled into the stream for fish habitat improvement. Cover is a major limiting factor for fish survival and production. The lack of additional instream wood would have an indirect and direct adverse effect to fish abundance. Fish survival and production would not increase in the short- or long-term.

There is no long-term benefit to trout or federally-listed threatened coho salmon because of the lost opportunity of limited road work, habitat enhancement, and no riparian thinning. Coho salmon and trout population trends would remain low but within the range of natural variability in the watershed.

Alternative F would provide a moderate level of improvement to road erosion, habitat complexity, and fish passage. The efforts would have indirect short- and long-term beneficial effects to trout and salmon survival and production. The high number of instream logs and stream-crossing upgrades would be an ambitious improvement in fish population trends, yet maintain a near remnant population within the range of natural variability.

The combined Riparian Reserves, limited instream and road restoration plans, combined with no riparian thinning would cause a modest long-term beneficial indirect and direct effect to fish population survival and production. Trout and salmon population trends would greatly increase in Alternative F. Overall, population survival and production would improve from the addition of instream wood. The aquatic condition in the watershed is a continued long-term adverse effect to insect and fish abundance. Trout and salmon populations would remain at or above a remnant level yet within the range of natural variability.

Cumulative Effects

Implementation of road projects would decrease chronic erosion up to 46 per cent (Boise 1999).

Chronic erosion from natural surface roads is of high concern and from gravel roads is a moderate concern. The main concern with gravel roads is not during normal road use but the season after high road use associated with timber harvest. Chronic erosion, especially from natural surface and gravel roads, potentially causes a direct long-term adverse effect and decreases the insect abundance from fine sediment eroding to the streams. Sediment can cover insect habitat and can produce an indirect long-term adverse effect to trout and salmon abundance from a decrease in insect abundance.

Road density would remain high, primarily from the large number of non-Federal roads. Road densities on the average would not change more than 0.5 miles per square mile for this alternative and all others. Episodic erosion would provide gravel and wood to streams would cause a modest increase in fish population survival and production. Episodic erosion would cause additional sediment to streams and have similar effects as chronic erosion. Populations typically rebound in the short-term from chronic and episodic disturbances. The addition of large wood and small woody material would help compensate for the lack of instream wood (Minshall 2003, 155-161).

The effects of harvest and road activities on private lands would cause a long-term direct effect or decrease in insect abundance from sediment deposited in the streams, and a short-term indirect adverse effect to fish populations. The long-term effect would result from the lack of road decommissioning on private lands.

The effect of herbicide application on private lands would be negligible to fish. Standard application procedures would minimize herbicides in the stream and no direct application to streams would occur. There are no anticipated effects to fish population survival or production outside the range of natural variability.

The following is a determination of effects for Southern Oregon/California (SONC) threatened coho salmon, SONC critical habitat, and Essential Fish Habitat (EFH) from implementation of Alternative F. The result of salvage activities would be a “May Affect, Not Likely to Adversely Affect” determination, because of negligible effects anticipated from salvage. The result of restoration activities are a “May Affect, Not Likely to Adversely Affect” determination because of an anticipated more than negligible effect from sediment disturbance to insect habitat and abundance. This slight possibility may indirectly effect the growth of an individual fish. Restoration activities would cause a short-term adverse effect and a long-term beneficial effect to an individual. Any effects would be minimized by the project design features.

Effects of Alternative G (Preferred Alternative) on Populations and Habitat

- Alternative G would greatly decrease and improve road erosion, fish passage, and habitat complexity and would have indirect short- and long-term beneficial effects to trout and salmon survival and production.
- Watershed improvements would ambitiously improve fish population trends yet maintain a remnant population within the range of natural variability.
- The intensity and duration of cumulative effects result in an ambitious improvement in fish population survival and production which remains near a remnant level within the range of natural variability.

The following effects are the same in all drainages within the Elk Creek Watershed.

Direct and Indirect Effects

Alternative G includes a moderate level of restoration and includes 2.6 miles of road reconstruction, 11 stream-crossing culvert sites for mid-slope road improvements, 100 miles of road maintenance, and 35 miles of decommissioning. Temporary road construction would add 0.9 miles of short spur roads on ridge tops. Road density would decrease a small amount.

Large pooling of sediment behind upland culverts on intermittent streams is a concern and can cause chronic erosion. Implementation of road projects would decrease chronic erosion up to 46 percent (Boise 1999).

Mass wasting from potential road failures would be minimally reduced in Alternative G at 11 sites. Mid-slope culverts on intermittent streams with road fills have the largest potential for episodic erosion. These episodic erosion events would continue to cause a short-term indirect and direct adverse effect to fish from the addition of sediment. It would cause a long-term beneficial direct effect from gravel recruitment and addition of woody material and would cause enhanced fish spawning and rearing.

The high level of road improvements in Alternative G would greatly improve chronic and episodic erosion and would have a substantial long-term indirect beneficial effect to trout and salmon survival and production.

Alternative G includes a moderate level of fish habitat improvement with installation of 5 rock weirs and 20 logs per mile, and a high level with gravel placement. Weirs would collect spawning gravels, develop plunge pools, and provide rearing habitat for juvenile fish. The improvement of instream habitat complexity with weirs and large woody debris would modestly improve trout and salmon survival and production.

The result of the improvements would be a short- and long-term benefit to trout and federally-listed threatened coho salmon from the habitat enhancement. Coho salmon and trout population trends would increase from low to moderate but within the range of natural variability in the watershed.

Thinning 359 acres of trees in the Riparian Reserve in Alternative G would reduce competition between small and large trees. Larger trees would be allowed to grow faster and fall into the stream for fish habitat sooner than a natural occurrence. Additionally, small diameter trees and large trees would be pulled into the stream as woody material for improvement of fish habitat complexity. Thinning would contribute a short- and long-term direct and indirect beneficial effect to fish from improved tree stand condition, and increased insect and fish abundance. The large woody debris and small diameter woody material provides cover and an immediate benefit by improving survival and production.

Alternative G is an ambitious effort to improve road erosion, habitat complexity, and improve fish passage. The efforts would have indirect short- and long-term beneficial effects to trout and salmon survival and production. Watershed improvements would improve fish population trends yet maintain a population within the range of natural variability.

The combined Riparian Reserves, and instream, riparian, and road restoration plans would cause a long-term beneficial indirect and direct effect to fish population survival and production. Trout and salmon population trends would greatly increase in Alternative G. Overall, population survival and production would improve substantially from the addition of instream wood. The aquatic condition would continue in a long-term adverse effect to insect and fish abundance within the watershed. Trout and salmon populations would remain at or above a remnant level yet within the range of natural variability.

Cumulative Effects

Implementation of road projects would decrease chronic erosion up to 46 per cent (Boise 1999).

The intensity of chronic erosion from natural surfaced roads is a high concern, and gravel surface roads are a moderate concern. The large pooling of sediment behind upland culverts on intermittent streams and chronic erosion of fine sediment would continue to moderately decrease insect and fish abundance from natural surface roads.

Road density would remain high, primarily from the large number of non-Federal roads. Road densities on the average would not change more than 0.5 miles per square mile for this alternative and all others. Episodic erosion would provide gravel and wood to streams and would cause a modest increase in fish population survival and production.

Episodic erosion would cause additional sediment to streams and have similar effects as chronic erosion. Populations typically rebound in the short-term from chronic and episodic disturbances. The addition of large wood and small woody material would help compensate for the lack of instream wood (Minshall 2003, 155-161).

Alternative G would include harvesting on 11 acres within Riparian Reserves located in 3 research units. Harvest methods would not deteriorate streambanks. Any possible sediment entering the stream from harvest in the research units would be a short-term negligible adverse indirect effect to fish and fish populations.

The effects of harvest and road activities on private lands would cause a short-term direct effect or decrease in insect abundance from sediment deposited in the streams, and a short-term indirect adverse effect to fish populations. The long-term effect would occur from the lack of road decommissioning on private lands. The effect of herbicide application on private lands would be negligible to fish. Standard application procedures would minimize herbicides in the stream. No direct application to streams is allowed. There are no anticipated effects to fish population survival or production.

The following is a determination of effects for Southern Oregon/California (SONC) threatened coho salmon, SONC critical habitat, and Essential Fish Habitat (EFH) in regard to implementation of Alternative G. The result of salvage activities would be a “May Affect, Not Likely to Adversely Affect” determination, because of negligible effects anticipated from salvage. The result of restoration activities are a “May Affect, Not Likely to Adversely Affect” determination because of an anticipated more than negligible effect from sediment disturbance to insect habitat and abundance. This slight possibility may indirectly effect the growth of an individual fish. Restoration activities would cause a short-term adverse effect and a long-term beneficial effect to an individual. Any effects would be minimized by the project design features.

3.6 Vegetation

- There are 4 plant series within BLM-administered lands in the Elk Creek Watershed.
- Seral stages have been altered by the Timbered Rock Fire. On BLM-administered land, pre-fire, 76 percent of the watershed was in late seral condition. Post-fire, 68 percent is in late seral condition.
- Outside the fire perimeter in the watershed, many upland areas and riparian areas have stand densities above the historic range, and historic pine areas have species compositions no longer dominant to pine.
- Bark beetle and wood borer populations tend to increase after fire; however, outbreaks are usually localized in the burned area and in trees adjacent to the fire.

3.6.1 Methodology

Maps and associated information in the Elk Creek Watershed Analysis were used to provide pre-fire information on the watershed scale which encompasses 85,424 acres. The South Cascades Late-Successional Reserve Assessment (LSRA) was used to obtain information on BLM-administered lands within the LSR. The area burned in the Timbered Rock Fire is within the boundary of this reserve and includes 11,774 acres of BLM-administered land.

The fire area was mapped using aerial photo imagery to divide the fire into four burn severity classes; high, moderate, low, and very low/unburned. A GIS layer was created using these classifications. This was then quality checked with helicopter flights over the fire area and visits on the ground to areas in question. The burn severity map theme was intersected with a map of the stand data from the Forest Operations Inventory (FOI) theme to determine seral stage of stands by burn severity. A land ownership theme was also intersected with these themes to provide these classifications by ownership.

Using the resulting maps, stand exams were performed on the four severity classes on BLM-administered land. In the mapped high and moderate burn areas, plots were taken at a rate of 1 every 5 acres with a minimum of 5 plots in any unit greater than 5 acres. In the high and moderate burn severity units, a plot consisted of a variable plot for trees over 8" DBH, and one fixed plot for trees 4-8" DBH. In the low and unburned severity area, 10 percent of the area was sampled. In these areas a plot consisted of a variable plot for trees over 8" DBH and a fixed plot for vegetation 4-8" DBH, with the addition of a second fixed plot that collected information on vegetation 1-4" DBH. A downed wood transect for 200 linear feet was also performed along with every stand exam plot in all 4 severity classes. The data was then entered into the Atterbury stand exam program for statistical summary reports for these units. It was also entered into the Coarse

Woody Debris (CWD) program to obtain information on existing downed wood. The reports generated were used to obtain site-specific information on the existing vegetation conditions in the fire area. A more detailed explanation of the stand exam procedure is available in Appendix D, Salvage.

3.6.2 Affected Environment

3.6.2.1 Late-Successional Habitat

Late-successional habitat, as described in the Northwest Forest Plan, includes mature and old growth age classes, which are generally stands over 80 years old. This habitat is characterized by "(1) multispecies and multilayered assemblages of trees, (2) moderate-to-high accumulations of large logs and snags, (3) moderate-to-high canopy closure, (4) moderate-to-high numbers of trees with physical imperfections such as cavities, broken tops, and large deformed limbs, and (5) moderate-to high accumulations of fungi, lichens, and bryophytes." (USDA and USDI 1994, B-5). Late seral habitat, as defined for this project, is stands over 80 years old. This includes all late-successional habitat, however all late seral habitat is not in late-successional condition. Some areas do not have all of the characteristics of late-successional habitat as described.

Plant Series

Plant series is a major stratification of habitat named after the dominant plant species in the final stage of ecological succession. Four major plant series are found within the Elk Creek Watershed and LSR: Douglas-fir (PSME), White fir/Grand fir (ABCO), Oregon White Oak (QUGA), and Ponderosa pine (PIPO). These plant series, except for the Ponderosa pine (PIPO) series, are also found within the fire perimeter (USDA and USDI 1998) (see Map 3-10).

Approximately 760 acres (3 percent) of the watershed and 550 acres (5 percent) of the fire area, on BLM-administered land, are considered non-forested areas. These areas are not classified into a forest plant series and are generally rock outcrops or meadows.

Pre-fire

White fir (ABCO – *Abies concolor*)

The White fir (ABCO) series generally occurs on cool sites with highly productive lands and high vascular plant species diversity (USDA and USDI 1996, ABCO 2). This series comprises 8,897 acres (37 percent) of the watershed and 4,870 acres (41 percent) of the fire area on BLM-administered land. These stands generally occur above 3,000' in elevation and are most common on the northerly aspects. A typical overstory is dominated by both white fir and Douglas-fir, with sugar pine and incense cedar occurring in much lower densities. Ponderosa pine is present on only the drier sites. The understory has similar species of conifers, with white fir generally occurring in higher densities than Douglas-fir, and ponderosa pine being absent. Madrone and chinquapin are also present in the understory. The shrub layer consists of creeping snowberry, baldhip rose, creambush ocean-spray, and dwarf Oregongrape.

Douglas-fir (PSME – *Pseudotsuga menziesii*)

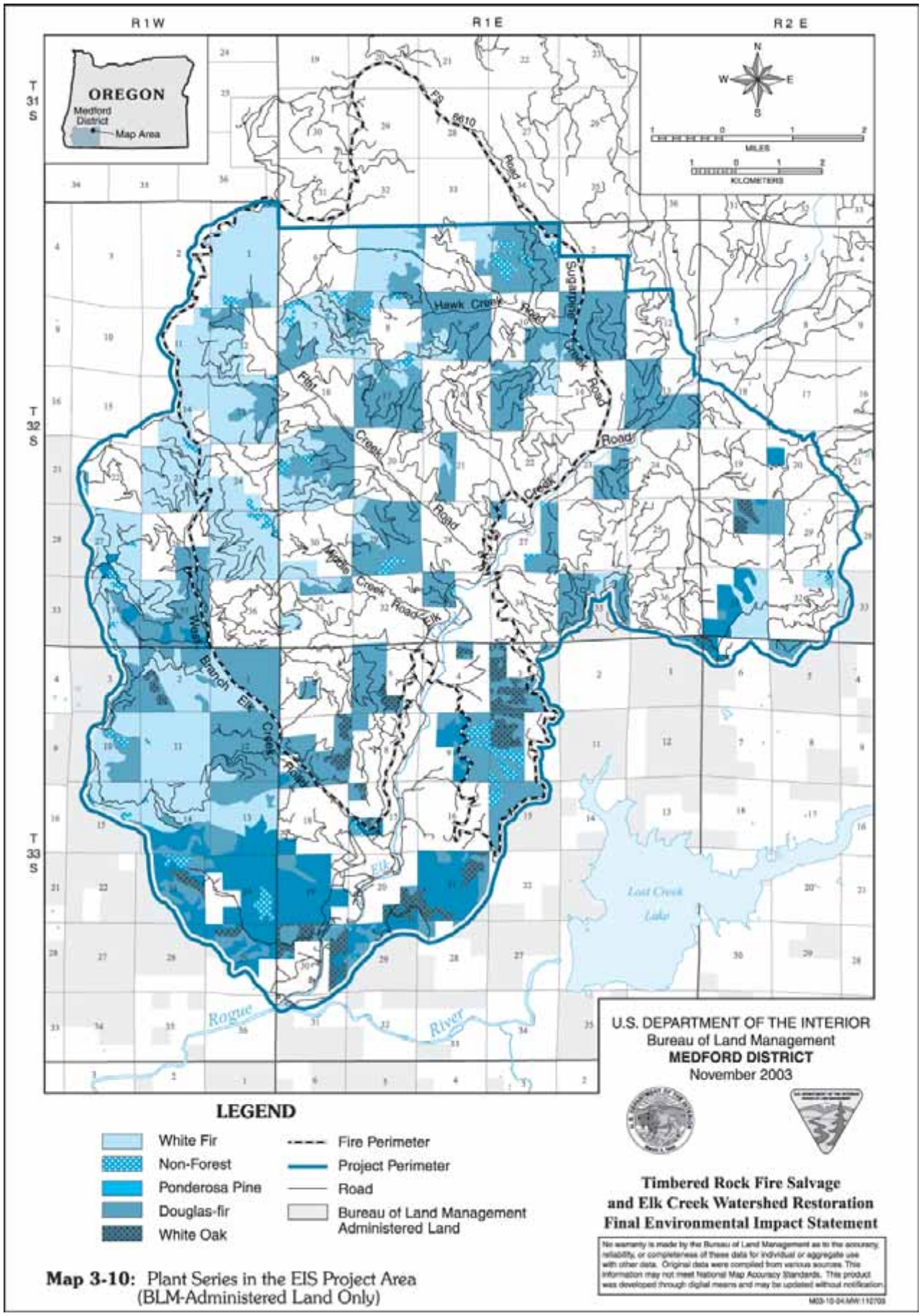
The Douglas-fir series is the most common series in the fire area and the watershed. This series occurs at all elevations and aspects, but less frequently than the white fir series on northerly aspects above 3,000' in elevation. On BLM-administered land, the Douglas-fir series occupies 10,445 acres (47 percent) of the watershed and 5,912 acres (50 percent) of the fire area. Overstory presence of Douglas-fir indicates disturbance, while its presence and dominance in the understory can indicate the hot, dry conditions characteristic of the series. The overstory of this series is typically dominated by Douglas-fir, although many other species are also found in the overstory, particularly sugar pine, incense cedar, white fir, and, on the drier sites, ponderosa pine. The understory is often comprised of Douglas-fir, madrone, canyon live oak, and incense cedar. Common shrubs include baldhip rose, dwarf Oregongrape, poison oak, creambush ocean-spray, and deerbrush ceanothus (Atzet, et al. 1996, PSME 2-4).

Ponderosa Pine (PIPO – *Pinus ponderosa*)

The ponderosa pine series is found near valley bottoms at slightly higher elevations than the Oregon white oak series. It occurs on all slope positions and aspects. The PIPO series is more drought-resistant than the Douglas-fir series and is found more frequently on mid-slopes and south aspects, often on shallow rocky soils. The PIPO series occupies 2,739 acres (11 percent) on BLM-administered land in the watershed and is not found in the fire area. Ponderosa pine regeneration is stimulated by fire and excluding fire restricts regeneration (Atzet, et al. 1996, PIPO 1-3). Ponderosa pine is dominant in the overstory and understory with Douglas-fir a major component of both on the wetter sites. Incense cedar, California black oak, and madrone may also be found in the understories.

Oregon white oak (QUGA – *Quercus garryana*)

The Oregon white oak series is found on the lowest elevations of the watershed, generally in the valley bottoms or nearby and on the shallower soils. On BLM-administered land, the Oregon white oak series occupies 1,026 acres (4 percent) of the watershed and 455 acres (4 percent) of the fire area. The overstory and understory are dominated by Oregon white oak with Douglas-fir and ponderosa pine present in varying densities, and occasional patches of incense cedar occurring. The shrub layer includes poison oak, baldhip rose, and buckbrush ceanothus (Atzet, et al. 1996, QUGA 1-4).



Map 3-10: Plant Series in the EIS Project Area (BLM-Administered Land Only)

Post-fire

The plant series remained unchanged in the fire area. Some localized sites may have received such a high burn severity that the physical characteristics of the soil were altered. As a result, the same vegetation regimes would not be supported. It is unlikely this occurred except possibly in isolated spots where a very high concentration of fuel existed, such as decked logs or dense concentrations of blowdown trees.

While the plant series did not change as a result of the Timbered Rock Fire, conditions that existed before the fire were outside the historic range before the advent of fire exclusion. Due to the lack of fire and past partial cutting of the overstory, greater densities of young conifers mixed with shrub and hardwood species existed on BLM-administered land in much of the area. There was also a greater number of early seral stands of conifers in plantations from planting of past overstory harvest. The stands that burned at hot and moderate severity have been returned to early seral condition. However, these areas are still capable of supporting stands described in the plant series. The treatment alternatives described in this EIS cover a range of possible treatments designed to return these areas to forested stands.

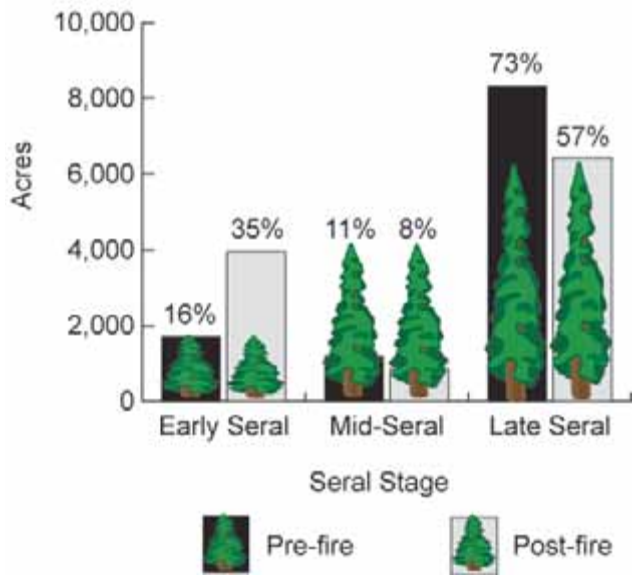
Seral Stages

Pre-fire

Seral stages are determined by the ecological progression from bare ground to the final stage in ecological succession. The vegetation within these series has been stratified into three seral stages: Early, Mid-, and Late (USDA and USDI 1998, 43). Generally, stands with dominant tree ages over 80 years fit into the late seral category, stands less than 30 years fall in the early seral stage, and those stands from 30 to 80 years occupy the mid-seral category.

The seral stages are important components of late-successional forest habitat. Ideally, the LSR in this watershed (Elk Creek) has a desired future condition of at least 55 percent in late seral habitat with Riparian Reserves having 75 percent in late seral vegetation (USDA and USDI 1998, 113). Within the fire perimeter, pre-fire, 73 percent of the BLM-administered land was in late seral condition. Post-fire, 57 percent of the BLM-administered land was in late seral condition. In the total Elk Creek Watershed, pre-fire, 76 percent of BLM-administered land was in late seral condition (see Map 3-11). Post-fire, 68 percent was in late seral condition. Table 3.6-1 and Figure 3.6-1 provide a summary of the large scale changes on BLM-administered land within the fire perimeter as a result of the more severely burned portions of the fire.

Figure 3.6-1. Seral Stages within the Timbered Rock Fire Perimeter



The seral stage distribution within the Elk Creek Watershed on BLM-administered land outside the fire perimeter is shown in Table 3.6-2.

Table 3.6-1. Pre- and Post-fire Seral Stage Acreages by Plant Series within the Timbered Rock Fire Area on BLM-administered Lands.

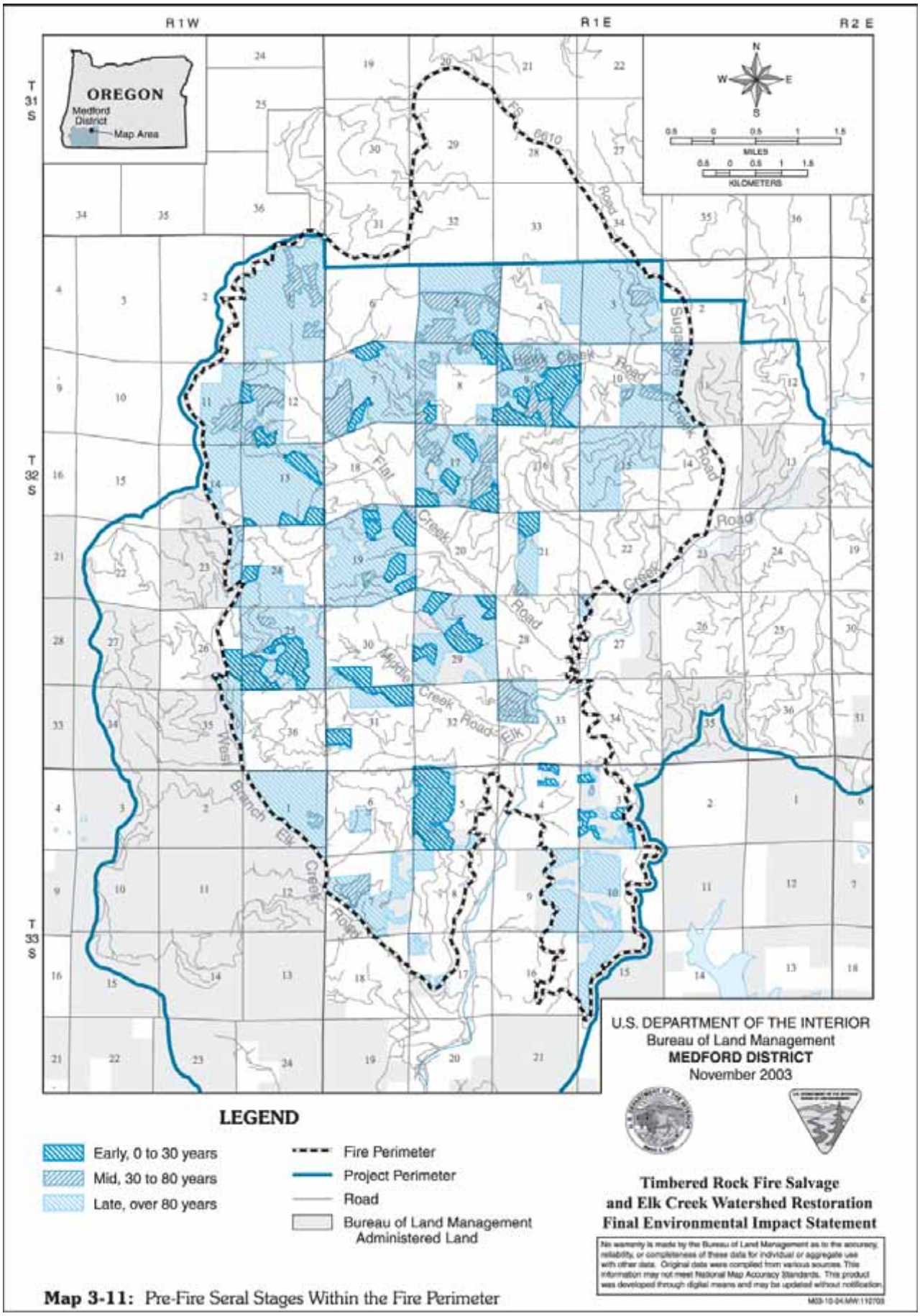
	Pre-fire			Post-fire		
	Early Seral	Mid-Seral	Late Seral	Early Seral	Mid-Seral	Late Seral
ABCO	578	538	3,754	1,431	438	3,001
PSME	1,085	659	4,168	2,204	406	3,302
QUGA	46	0	399	306	0	139
Total	1,709	1,197	8,321	3,941	844	6,442

NOTE: There are 547 acres of non-forest land (meadows, rock outcrops) within the fire perimeter not shown on the table.

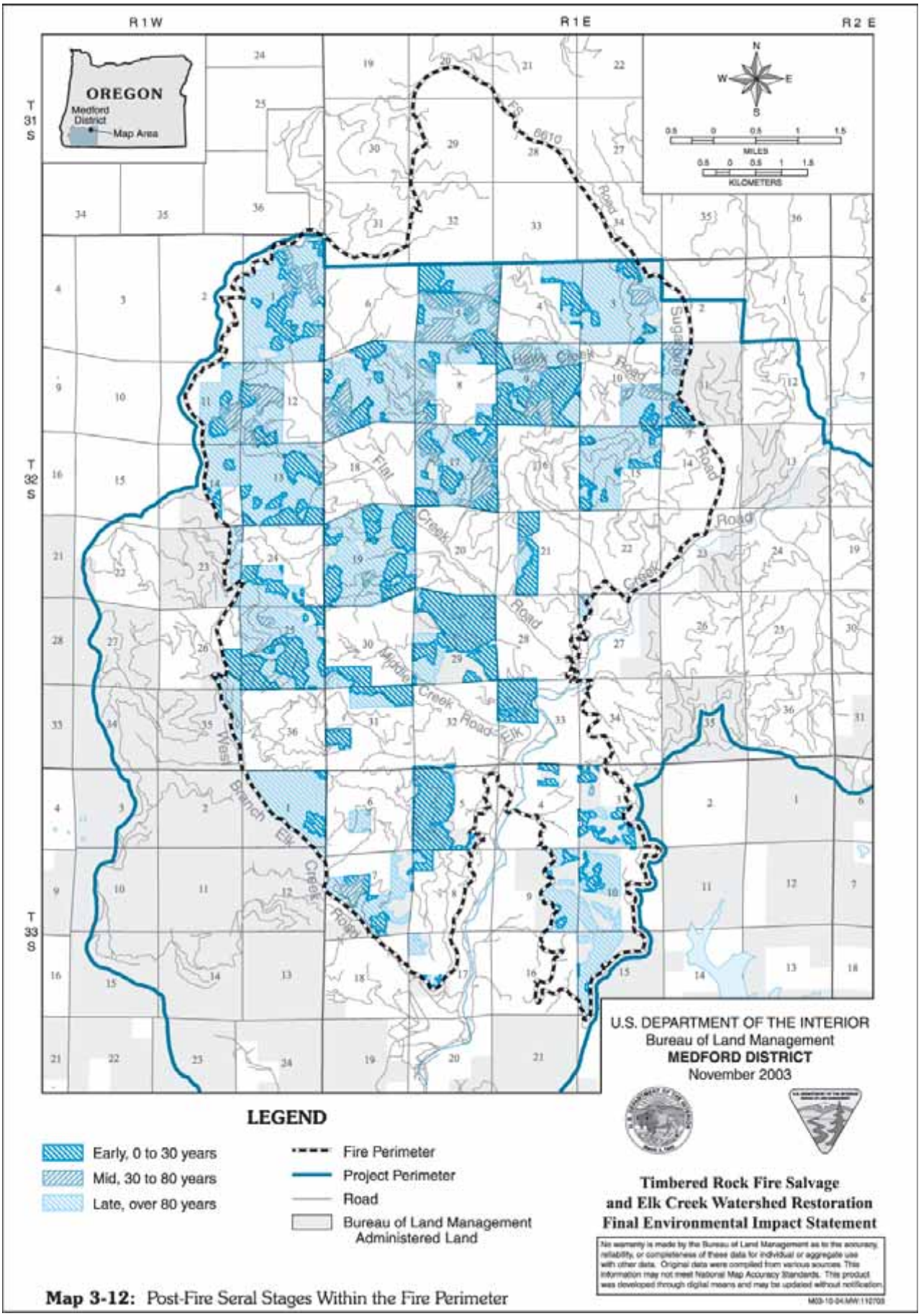
Table 3.6-2. Seral Stage Distribution by Plant Series Outside the Fire Perimeter within Elk Creek Watershed on BLM-administered Lands

Plant Series	Early Seral	Mid-Seral	Late Seral
ABCO	605	248	3,173
PSME	844	737	2,952
QUGA	1	0	580
PIPO	97	100	2,542
Total	1,547	1,085	9,247

NOTE: There are 306 acres of non-forest land (meadows, rock outcrops) within the watershed outside of the fire perimeter not shown on the table.



Map 3-11: Pre-Fire Seral Stages Within the Fire Perimeter



Map 3-12: Post-Fire Seral Stages Within the Fire Perimeter

Post-fire

The seral stage of many areas within the fire has changed. The change is a function of the severity of the burn. In areas where the majority of the existing overstory vegetation was killed, the seral stage returned to early seral, unless it was already in that stage. In areas where the fire burned light, the seral stage remained unchanged.

The fire burned in a variable pattern both spatially and in severity across the fire area (see Map 3-12). Areas that burned at a low severity received a light underburn. Many of these areas only have changes to the understory component and did not change seral stage. The early seral stage areas that burned have very low survival rates, compared to stands in late seral condition. They remained in early seral condition, however with less vegetative cover than before the fire, regardless of the plant series. In the high burn severity areas, all seral stages generally received greater than 90 percent mortality, regardless of plant series. The high burn severity areas, along with the moderate burn severity areas, were all returned to early seral conditions.

Table 3.6-3 and Figure 3.6-2 provide summaries of the large-scale changes to BLM-administered land within the Elk Creek Watershed as a result of the more severely burned portions of the fire.

Table 3.6-3. Pre-and Post-fire Seral Stage Acreages by Plant Series within the Elk Creek Watershed on BLM-administered Lands

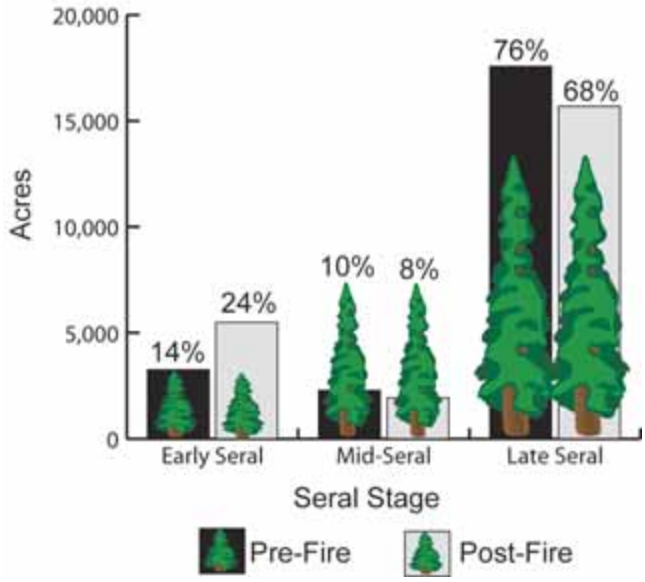
Plant Series	Pre-fire			Post-fire		
	Early Seral	Mid-Seral	Late Seral	Early Seral	Mid-Seral	Late Seral
ABCO	1,183	786	6,928	2,038	686	6,173
PSME	1,929	1,396	7,120	3,048	1,143	6,254
QUGA	47	0	979	307	0	719
PIPO	97	100	2,542	97	100	2,542
Total	3,256	2,282	17,569	5490	1,929	15,688

NOTE: There are 759 acres of non-forested areas (meadows, rock outcrops) within the watershed not shown on the table.

Overall, on BLM-administered lands in the Elk Creek Watershed, the early seral stage acreage was increased by 2,234 acres from 14 percent to 24 percent of the watershed. The mid-seral stage acreage was reduced by 353 acres from 10 percent to 8 percent of the watershed. The late seral stage acreage was reduced by 1,880 acres from 76 percent to 68 percent of the watershed.

Table 3.6-4 and Figure 3.6-3 show the acres burned in each plant series by severity level on BLM-administered land. The associated graphs depict which plant series received the highest burn severity. As expected, the ABCO series,

Figure 3.6-2. Seral Stages within the Elk Creek Watershed



which has the highest elevations and more northerly aspects, received the least amount of high and moderate burn severity. The PSME series was next, with the QUGA series, which is the lowest in elevation, receiving the greatest percentage of high and moderate burn severity. Generally, high burn severity areas are characterized by less than 10 percent overstory canopy, moderate burn severity 10 to 40 percent live canopy, low severity 40+ percent live canopy, and very low severity has the pre-fire overstory intact.

Plantations

Pre-fire

Approximately 1,800 acres of conifer plantations are located on BLM-administered land within the fire perimeter. Most of these areas were planted on an 8' by 8' spacing, approximating 680 trees per acre. These stands varied in age from 5-40 years old. They are all stocked with conifers at varying levels, however 80 percent of the plantations were planted once, 17 percent were planted twice, and 3 percent were planted three times. The average stocking level on the units planted once is 246 trees per acre. The average stocking level on the units that received more than one planting was 171 trees per acre prior to replanting. These levels of stocking are the result of planting, seedling protection measures, and release treatments to these stands.

Post-fire

Approximately 1,700 acres in early seral stage were burned on BLM-administered land. Of these areas, about 1,275 acres were burned with high and moderate severity, killing the majority of the trees on that acreage. Very limited conifer seed sources remain within the burned planted areas, as there are few remnant overstory trees in these older past harvest areas. Approximately 1,000 acres in old plantations and high

Table 3.6-4. Acres Burned in Each Plant Series by Severity Level on BLM-Administered Land

Plant Series	High Severity		Moderate Severity		Low Severity		Very Low/ Unburned		Total	
ABCO	198	(4%)	1,045	(21%)	2,102	(44%)	1,526	(31%)	4,871	(100%)
PSME	716	(12%)	1,218	(21%)	1,797	(30%)	2,180	(37%)	5,911	(100%)
QUGA	41	(9%)	225	(51%)	148	(33%)	31	(7%)	445	(100%)
Total	955		2,488		4,047		3,737		11,227	

NOTE: There are 547 acres of non-forest land (meadows, rock outcrops) within the fire perimeter not shown on the table.

burn severity acres were replanted in 2003.

The vegetation, across all land ownerships, in the Elk Creek Watershed is a patchwork of mature forests, past timber harvest areas, and natural meadows in the upland portion of the watershed. The lower portion, along Elk Creek, is mainly farmland, hay fields, and pastures.

Habitat within the Watershed but Outside Fire Perimeter

Within the Elk Creek Watershed, there are approximately 2,000 acres of stands between 10 and 80 years of age on BLM-administered land, primarily outside of the fire perimeter, with abnormally high tree densities. These stands are generally the result of lack of fire after decades of fire exclusion. These stands include areas with densities of over 1,000 trees per acres under 8" DBH and 200 trees per acre

Figure 3.6-3. Plant Series Burn Severity on BLM-administered Lands

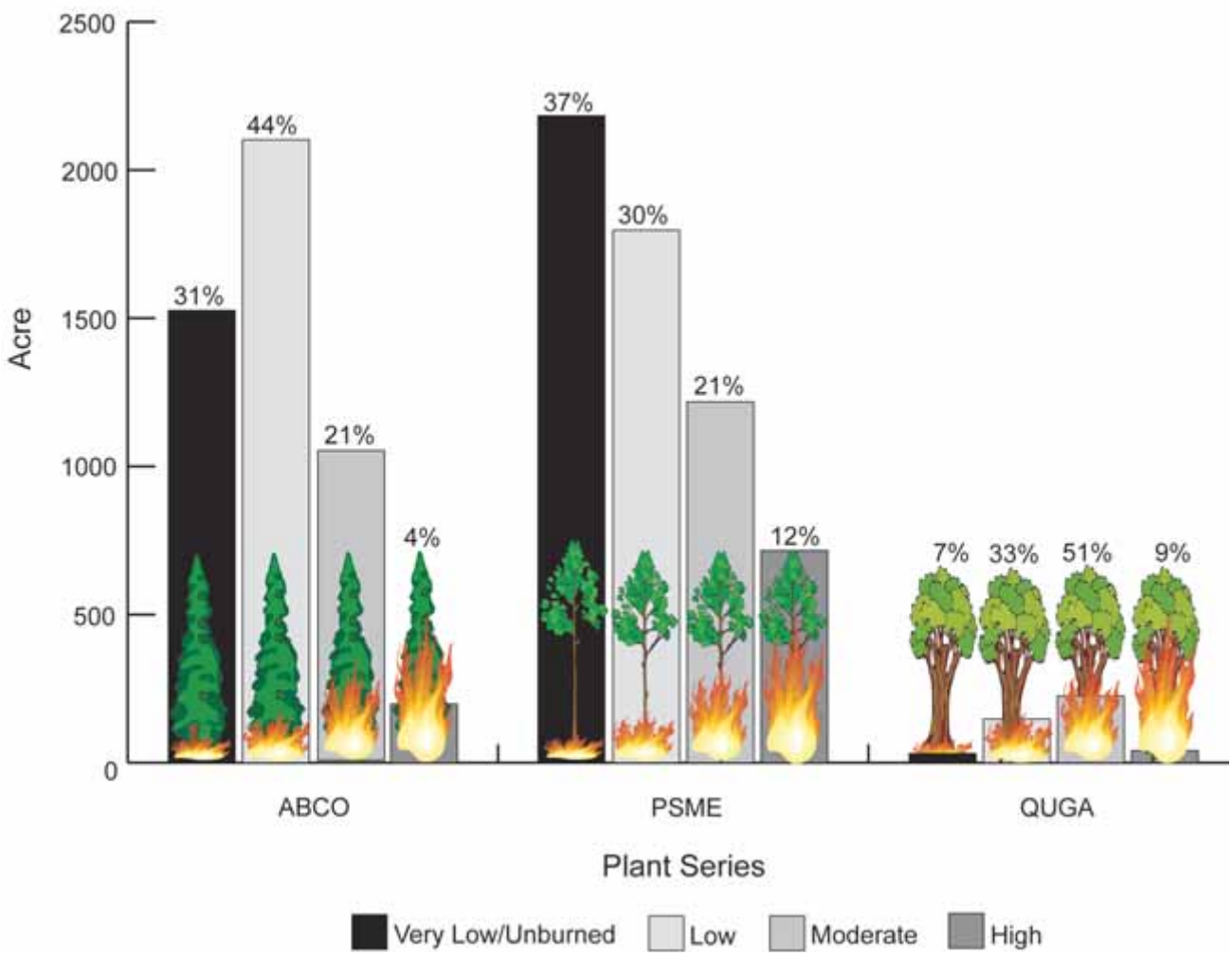


Table 3.6-5. Elk Creek Watershed Successional Stages

Classification	Acres	Seral Stage	Acres
Barren	297	Open / Meadows	1,037
Grass/Forb	740	Open / Meadows	
Shrub	1,717	Early Seral	7,022
Early	5,305	Early Seral	
Open Canopy (>11" DBH, <40% crown closure)	2,628	Mid-Seral	28,620
Mature (11-17" DBH, >40% crown closure)	25,992	Mid-Seral	
Mature (17-24" DBH, >40% crown closure)	33,125	Late Seral	48,683
Late-Successional (>24" DBH, > 40% crown closure)	15,558	Late Seral	
Total	**85,362**		**85,362**

from 8" DBH to 16" DBH. These densities are outside the range suggested for natural development of late-successional habitat characteristics (Tappeiner, et al. 1997, 648).

BLM-administered lands outside the fire perimeter, within the Elk Creek Watershed, contain lands classified within the ponderosa pine (PIPO) plant series and areas where ponderosa and sugar pine are dominant in the overstories. Approximately 2,500 acres fit these categories. These stands have densities of up to 1,500 trees per acre less than 8" DBH and 200 trees per acre from 8" DBH to 16" DBH. These densities are greater than what occurred before fire exclusion with a normal fire regime. Many of these stands were historically dominated by pines but presently are dominated by Douglas-fir and other species. The regeneration is also dominated by species other than pine, due to the high tree densities from lack of fire activity.

Over 1,000 acres of riparian areas have varying densities of conifers and hardwoods. Many are lacking in large conifers and structural variability. Many of these stands are dominated by trees in mid-seral conditions, and shrub species and patches of dense young conifers in early seral age classes. The most dense areas have up to 900 trees per acre under 8" DBH and 200 trees per acre over 8" DBH; however, these densities are not uniform across the riparian areas. In stands less than 8" DBH, where the conifer and hardwood component is scattered, shrub densities tend to be quite high, with complete ground cover. The conifers in these areas show signs of suppression with slower growth rates and sparse branching patterns.

Habitat across all Ownerships within the Watershed

The NFP identifies these areas as needing “development of old growth forest characteristics including snags, logs on the forest floor, large trees, and canopy gaps that enable the establishment of multiple tree layers and diverse species composition” (USDA and USDI 1994, B-5).

Approximately 18.2 percent can be described as Late-Successional (>24" DBH and >40 percent canopy closure), 39.8 percent as mature (17-24" DBH and >40 percent canopy closure), and 30.4 percent was classified as mature (11-17" DBH and >40 percent canopy closure). Approximately 3.1 percent is in open canopy (>11" DBH and <40 percent canopy closure), 6.2 percent is in an early stage, 2 percent is in a shrub stage, 0.9 percent is in a grass/forb stage and 0.3 percent is barren (USDA and USDI 1996, 11-30). This information is from satellite imagery in the Elk Creek Watershed Analysis. It appears to underestimate the amount of vegetation in early seral condition, but is the best information available covering the entire Elk Creek Watershed. The figures in Table 3.6-5 represent pre-fire conditions and were taken from the Elk Creek Watershed Analysis page II-30.

Overall, on all lands in the Elk Creek Watershed, the early seral stage was increased by 8,233 acres from 8 percent to 18 percent of the watershed. The mid-seral stage acreage was reduced by 6,353 acres from 34 percent to 26 percent, and the late seral stage was reduced by 1,880 acres from 57 percent to 55 percent (see Table 3.6-6).

Table 3.6-6. Seral Stage Distribution on all Land Ownerships within the Elk Creek Watershed

Seral Stage	Pre-Fire	Post-Fire	Change
Open / Meadows	1,037	1,037	0
Early Seral	7,022	15,255	8,233
Mid-Seral	28,620	22,267	(6,353)
Late Seral	48,683	46,803	(1,880)
Total	**85,362**	**85,362**	

3.6.2.2 Insects

Pre-Fire

Insect populations, in particular conifer-dependent species, did not appear to be at unusually high levels prior to the fire. Populations have been cyclical in the past, but are generally higher following years of drought. Insect pathogens, in particular bark beetles and wood borers, are a part of the ecosystem across all the plant series. Many insects are host-specific. In this area, the Douglas-fir beetle (*Dendroctonus pseudotsugae*) is specific to Douglas-fir (USDA no date). The western pine beetle (*Dendroctonus brevicomis LeConte*) is primarily in ponderosa, and the mountain pine beetle (*Dendroctonus ponderosa*) uses lodgepole, ponderosa and sugar pines (USDA 1989, 1-2; USDA 1982, 1-6). The flatheaded fir borer (*Melanphila drummondi)* invades dead and weakened Douglas-fir (Ragenovich 1988, 14-15; Goheen 2003).

Isolated patches of insect activity have occurred on lands within the watershed, with individual trees and small groups of trees being attacked. This has been more common in low elevation areas with a pine component, indicating that the western and mountain pine beetle have been the most active. Douglas-fir beetle activity has been low in the watershed in the recent past.

Post-fire

The early seral stage acreage across all plant series on BLM-administered lands was increased by 2,234 acres. There are extensive numbers of standing dead hardwoods and conifers on these acres that changed seral stage from late or mid-seral to early seral. These dead trees are potential breeding habitat for bark beetles and wood borers. At the watershed level, the early seral stage was increased on all land ownerships by approximately 8,233 acres. The mid-seral stage acreage was reduced by approximately 6,353 acres and the late seral stage was reduced by 1,880 acres. Generally, the 8,233 acres that changed seral stage to early seral have many standing dead hardwoods and conifers (see Table 3.6-6).

All species of bark beetles and wood borers present before the fire would likely show an increase in activity within the fire perimeter and possibly within adjacent stands of live trees. Douglas-fir is the most common conifer in the fire area. The next generation of emerging adult Douglas-fir beetles would attack adjacent green trees. Douglas-fir beetles would not do well in standing green trees and an outbreak should be short-lived. Trees severely scorched or killed would be less suitable for beetle development than weakened or downed green trees, as the cambium is often too damaged from heat (Ragenovich 1988, 14-15).

"Douglas-fir beetles prefer downed Douglas-fir but will attack standing, weakened, or dead trees." (Ragenovich 1988, 14-15). Douglas-fir beetles produce one generation per year. Broods remain in the tree and overwinter, emerging in the mid- to late spring (USDA 1996, 1-4).

The western pine beetle produces two generations per year. Generally, the beetles emerge in late spring and early autumn (USDA 1982, 1-6). "The western pine beetle prefers large over mature ponderosa pine. Populations can build up in the fire-damaged trees, emerge, and continue to attack apparently healthy green trees." (Ragenovich 1988).

The mountain pine beetle normally produces one generation per year with all four stages (egg, larva, pupa, and adult) spent under the bark, except for a few days in the summer when adults emerge and fly to new trees (USDA 1989, 1-5). The preferred hosts for this beetle are stressed and weakened pole-sized pines. This beetle is less often associated with fire damaged trees than the western pine beetle (Ragenovich 1988, 14-15).

The flatheaded fir borer inhabits trees already dead and attacks and kills Douglas-fir that have been stressed or weakened or are adjacent to a burned area. It is less important than the Douglas-fir beetle. Attacks can continue for several years, as long as the wood remains sound (Ragenovich 1988, 14-15).

Ponderosa pine is likely to become a host for the western pine beetle. Ponderosa and sugar pines are likely to become hosts for the mountain pine beetle. Both species of beetles prefer weakened fire-damaged trees to dead trees, standing or downed. Ponderosa and sugar pine are minor components of the watershed. The majority of the areas with pine present are in the south portion of the fire perimeter on south aspects, and in adjacent green stands in the southern portion of the watershed outside the fire perimeter. The ponderosa pine (PIPO) plant series is only present outside the fire perimeter, and encompasses 2,700 acres total on BLM-administered lands. Within the fire perimeter, ponderosa pine is dominant on a minor portion of the southerly aspects in the low elevation of the Douglas-fir (PSME) series. It is possible beetle populations would build in these stands, but it would likely be limited by the low amount of pine present in the watershed and the relatively isolated population of beetles present before the fire.

In most cases, based on observations on past southwest Oregon wildfires, insect populations have not built up to any substantial amount in stands outside of the wildfires. It is very likely fire-damaged trees would be infested and killed by insects for at least four years after the fire. Outbreaks of large beetle populations have most always been in cases where beetle populations were high and insects were active in the area before the fire (Goheen 2003). Infestations of adjacent stands by both Douglas-fir beetle on Douglas-fir and western pine and mountain pine beetle on pines would likely be limited to stands adjacent to or within the fire perimeter.

Insects in general, and associated disease organisms, are integral parts of the forest ecosystem. They help decompose and recycle nutrients, build soils, and can help maintain genetic diversity within tree species. Wood borers start the decomposition process on downed wood by breaking down the dead wood, especially the downed material. Some wildlife species depend on insects for food and creation of habitat (Peters, Frost, and Pace 1996).

3.6.3 Environmental Consequences

This section includes discussions regarding late-successional habitat including site productivity and forest-dependent insect populations. Discussions involve the effects of salvage harvest of fire-killed trees, at varying levels, and the effects of restoration activities, at varying levels, in late-successional upland habitat areas, pine habitat, and riparian areas (see Table 3.6-7).

Table K-1 in Appendix K provides descriptions of stands 50 years in the future, based upon proposed treatments by alternatives. Table 2-4 describes the stands in the high and moderate burn severity areas at 15, 50, and 80 years in the future under Alternative G. Table 2-5 projects stands in 5 and 50 years after restoration treatments to existing forest stands.

3.6.3.1 Late-Successional Habitat

Effects Common to all Alternatives

Salvage

Direct and Indirect Effects

Salvage proposals within each alternative leave varying levels of snags and coarse woody debris as prescribed by various models, advisors, and documents pertaining to attainment of late-successional habitat. In all salvage alternatives, it is assumed most fire-killed trees under 16" DBH would be retained on site and contribute to the coarse woody debris retention. These trees would have little commercial value at the time this project could be implemented due to decay and wood borers. Snags and woody debris provide important functions in the forest. Over the long-term, they contribute to soil fertility and serve as important structural elements to prevent erosion and provide habitat for organisms (Aber 2000, 9). Fire-killed trees of all sizes would fall down over time, with the smallest starting to come down within 5 years and some of the largest standing for decades. Two of the guidelines being used in the alternatives suggest differing levels of coarse woody debris retention based on plant series. The plant series was not changed by the fire, only the seral stages within that plant series. All alternatives maintain the existing plant series, and each alternative attempts to put the sites on a trajectory to attain late-successional habitat, however at different rates.

Salvage of roadside hazard trees, along BLM-managed roads, would occur in all alternatives except Alternatives A and B. These areas would have limited removal of fire-killed trees, primarily above the road. The areas that received high or moderate burn severity would have the majority of the hazard tree removal. This includes areas 200 feet above and below the road. Very few trees would be removed below the road. The overall impact would likely be to less than 100 acres of BLM-administered land over the entire fire area. The impacts would be negligible on the long-term late-successional habitat due to the small amount of land impacted and the close proximity of all of these acres to roads.

Restoration

Direct and Indirect Effects

Reforestation of the high and moderately burned sites varies by alternative. However the potential for natural regeneration in the fire area is similar through all alternatives. The majority of the hardwood tree species have actively begun to sprout. An abundance of cones is present on conifers burned in the high and moderate severity areas. However, since the fire started in mid-July, the number of seeds that were viable at that time is unknown. The later in the fire's progression an area burned, the greater the chance of the cones producing viable seed. Douglas-fir and ponderosa pine appear to make up the majority of the conifers that have retained cones after the fire swept through the canopy. These areas would have the greatest potential for natural regeneration.

Tree planting under all of the alternatives would occur in less dense patterns than have traditionally occurred on harvested or burned sites. Replanting would only occur when stocking levels fall below the normal densities used for determining replanting needs. This is to decrease the need for

Table 3.6-7. Proposed Restoration Activities within the Elk Creek Watershed by Alternative (acres)

	Alternative						
	A	B	C	D	E	F	G
LSR Habitat Restoration	0	1,102	1,328	1,328	1,978	0	1,328
Riparian Restoration	0	117	359	359	1,050	0	359
Pine Restoration	0	156	793	793	2,005	0	793
Tree Planting	6,000	1,992	2,152	2,152	6,000	1,045	2,152

future thinnings in order to hasten the development of late-successional characteristics.

Cumulative Effects

Approximately 6,000 acres of industrial forest land is planned to be salvaged. This represents approximately 7 percent of the Elk Creek Watershed. Large woody debris contributes to long-term soil fertility, nutrient cycling, and sustainable forest management (Aber, et al. 2000, 5 and 9). On all the acres returned to early seral stage due to the fire, it would take up to 80 years to return to late seral conditions. It is assumed industrial forest land included in the Elk Creek Watershed would never attain late-successional habitat, as it would be harvested before reaching that condition. Actions under all alternatives, on BLM-administered land, need to maintain existing late-successional habitat or promote the development of late-successional habitat.

Reforestation through tree planting would occur in all alternatives using mixed species native to the area. Areas and acreage planted would vary by alternative, with the highest priority areas being planted in all alternatives. It is likely most the acres harvested on industrial forest lands would be replanted also. This would help reduce the time needed for reforestation processes to occur and potentially accelerate the attainment of late-successional conditions on BLM-administered lands.

The 1,800 acres of past plantations within the fire area were primarily planted on an 8' by 8' spacing, which approximates 680 trees per acre (tpa). Proposed tree planting would be on a 10' by 10' spacing, which approximates 435 trees per acre. This would be 64 percent of the number of trees per acre planted previously on plantations in this watershed. These past plantations, at the time of the fire, averaged 246 trees per acre on areas planted once, which was 80 percent of the plantations. The remaining 20 percent of the plantations retained 171 trees per acre after the first planting. If this same survival rate holds true for areas planted on a 10' by 10' spacing, 80 percent of the areas would average 157 trees per acre (64 percent of 246 tpa), and the other 20 percent would average 109 trees per acre (64 percent of 171 tpa). It is not expected this exact proportion would hold true for areas planted under this proposal, but it is an indication of the trees per acre range expected in the years following planting.

No follow-up planting treatments, under any of the alternatives, would be implemented unless stocking falls below 100 trees per acre. This would more closely follow the guidelines for conifer density levels suggested for the development of late-successional habitat and the “heterogeneous spatial patterns of those structures” (Franklin 2001, 3; Tappeiner, et al. 1997, 648).

Planting at 10' by 10' with limited maintenance and release treatments, would allow for reforestation without the expense of post-planting treatments needed if planting were performed on a wider spacing. Survival of seedlings would tend to be more associated with microsites that would naturally support more trees, and less dependent on artificial release treatments to ensure survival of individual seedlings on sites less suited for tree growth.

Future harvest of trees in the LSR older than 80 years is not anticipated on BLM-administered lands, with the possible exception of trees around older overstory pine. Some harvest of trees up to 24" competing with the pine could occur.

Effects of Alternative A (No Action) on Late-Successional Habitat

Salvage

Direct and Indirect Effects

Under Alternative A, no salvage or restoration treatments would occur.

Since no harvest of fire-killed trees would occur, ample coarse woody debris and snags would remain on-site. Fire-killed trees of all sizes would fall down over time, with the smallest starting to come down within 5 years and some of the largest standing for decades. This material would add to both future site maintenance and potential for increased high fire severity. (Brown, et al. 2003, 2-9). Long-term site productivity would be maintained through conservation of organic material and retaining the coarse woody material for nutrient cycling and soil replenishment. Over the long-term, snags and woody debris provide important functions in the forest. They contribute to soil fertility and serve as important structural elements to prevent erosion and provide habitat for organisms (Aber, et al. 2000, 9).

Restoration

Direct and Indirect Effects

The objective of the restoration thinnings would be to reduce the time required for existing young and mid-seral forests to develop late-successional characteristics. There would be no restoration thinning under this alternative and stands would develop on their current trajectory. Growth rates would be reduced by an average of 36 percent, compared to similar stands thinned in both upland and riparian areas (Bailey 1996, 92). Some of the densest stands would eventually lose the opportunity to develop the branching patterns of old growth conifers on individual trees as they continued to develop as a very dense stand. There would be greater potential for loss of the densest stands in early and mid-seral stages to wildfire without the reduction of stand densities from thinning.

Cumulative Effects

Retention of fire-killed trees in Alternative A would allow for long-term conservation of structural elements, woody material, organic matter, and nutrient cycling in the fire area. Fire-killed trees would remain on site. These areas retain

coarse woody debris in excess of the amounts recommended by LSRA, DecAID Wood Advisor, Medford District RMP, and in the research paper "*Managing Coarse Woody Debris in Forests of the Rocky Mountains*" (Graham, et al. 1994, 8-11). Retention of fire-killed trees would add to both future site maintenance and potential for increased high fire severity. (Brown, et al. 2003, 2-9).

Conifer reforestation would begin through planting. Planting would occur on up to 6,000 acres of burned areas consistent with the ESRP. Hardwoods have begun to sprout from basal clumps. This would help reduce the time needed for reforestation processes to occur; however spatial variability and growth rate differentiation would not be promoted if existing replanting guidelines used on matrix land, are applied.

Fire-killed timber salvage on industrial forest lands would remove a substantial portion of the large woody material on those lands. Salvage logging could potentially occur on 6,000 acres within the fire area. Coarse woody material retention on these lands would likely be in patches, primarily in riparian areas, with the majority of the commercial size wood (greater than 8" DBH) harvested. This represents approximately 7 percent of the Elk Creek Watershed. Coarse woody debris contributes to long-term soil fertility, nutrient cycling, and sustainable forest management (Aber, et al. 2000, 5, 9). These benefits would be reduced on these areas.

On BLM-administered land, 2,048 acres of pre-commercial thinning in this watershed has occurred in the last 10 years. Approximately 1,000 of the 2,048 acres were damaged or killed in the fire and are now starting over at zero years of age. The remaining 1,050 acres of thinned stands outside the fire area have had accelerated growth on the residual trees in the stands. The lack of restoration activities in young stands within the watershed, in this alternative, would increase the time needed for these stands to achieve late-successional conditions. Thinning increases the diameter growth rates, live crown ratios, percentage of live intermediate level trees, and shrub cover in stands when compared to unthinned stands (Bailey 1996, 91-96). These characteristics are some of those associated with late-successional stands. Variable-density thinning can accelerate the development of old-growth characteristics (Rapp 2002, 7). Thinning on up to 5,000 acres of young stands would not occur, reducing the potential effect of acceleration of late-successional habitat development on 6 percent of the land within the Elk Creek Watershed.

The areas burned with high or moderate severity would be replanted on BLM-administered land. It is likely most acres harvested on industrial forest land would be replanted also. This would help reduce the time needed for reforestation processes to occur. Diversity of growth rates and spatial variability, which are desired late-successional characteristics, would not be promoted if replanting guidelines for Matrix land are implemented.

Effects of Alternative B on Late-Successional Habitat

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur. Effects on late-successional habitat would be similar to Alternative A.

Restoration

Direct and Indirect Effects

Low levels of restoration activities affecting late-successional habitat development are planned in this alternative. No activities would occur in stands with trees larger than 8" DBH. Thinning would occur on up to 1,375 acres of young stands less than 8" DBH, which constitutes 2 percent of the land in the Elk Creek Watershed. A majority of the severed trees would be piled and burned to reduce the fire danger within these stands. Accelerated growth rates on trees in the thinned stands would occur, with increased opportunity for those selected reserve trees to achieve old-growth characteristics at an earlier age than would occur without thinning. Thinning would also increase other late-successional characteristics such as increased live crown ratios, percent of live intermediate level trees, and increased shrub cover in stands when compared to unthinned stands. The risk of losing these stands to wildfire would be reduced through thinning by reducing crown continuity and connectivity. The lack of thinning in stands 30 to 80 years old would increase the time needed for these stands to achieve late-successional conditions, when compared to thinned stands.

Tree planting would occur on up to 3,016 acres of BLM-administered land, in the high and moderate severity burn areas. This would decrease the time necessary for these areas to regenerate to tree species, particularly conifers. Hardwoods have begun to sprout from basal clumps. Planting would not occur in burned areas less than 10 acres, and all areas would not be replanted unless stocking falls below 100 trees per acre. This would help increase the variability within and between stands of trees and aid in the early development toward late-successional habitat.

Cumulative Effects

Roughly 2,230 acres (3 percent of the Elk Creek Watershed) on BLM-administered land that burned at high or moderate severity and changed seral stages to early seral would not have fire-killed trees removed. These areas would allow for conservation of structural elements, woody material, organic matter, and nutrient cycling in the fire area.

There have been 2,048 acres of pre-commercial thinning in this watershed in the last 10 years. Approximately 1,000 of the 2,048 acres were damaged or killed in the fire and are now starting over at zero years of age. The remaining 1,050 acres of thinned stands outside the fire area have

had accelerated growth on the residual trees in the stands. As a result of the proposed thinning in young stands, approximately 2 percent (1,375 acres) of the watershed would have an increase in the growth rate on conifers in stands. Thinning increases the diameter growth rates, live crown ratios, percent of live intermediate level trees and shrub cover in stands when compared to unthinned stands (Bailey 1996, 91-96). This would reduce the time needed for those areas to become late-successional habitat.

The areas burned with high or moderate severity would be replanted on BLM-administered land. It is likely most acres harvested on private industrial land will be replanted also. This would help reduce the time needed for reforestation processes to occur. Replanting on BLM-administered lands would not occur until stocking falls below 100 trees per acre. Replanting on private land would likely be variable. This would add to the variability of tree growth rates and stand complexity, desirable for late-successional characteristics.

Effects of Alternative C on Late-Successional Habitat

Salvage

Direct and Indirect Effects

Under Alternative C, up to 247 acres of fire-killed trees would be removed. Salvage would occur in selected fire-killed stands over 10 acres in size. Areas not meeting the suggested levels and size classes of fire-killed trees for retention would not be harvested. Areas which exceed these levels of woody material, over 10 acres in size, would have only excess trees harvested. The area harvested would comprise less than 1 percent of the Elk Creek Watershed. Most snags and coarse woody material would be retained, maintaining long-term site productivity through conservation of organic material for soil fertility, nutrient cycling, and organisms for late-successional habitat (Aber, et al. 2000, 5, 9). Retention of most fire-killed trees would add to both future site maintenance and potential for increased high fire severity (Brown, et al. 2003, 2-9).

Restoration

Direct and Indirect Effects

Moderate levels of restoration projects would occur in this alternative. This includes thinning of conifers less than 8" DBH (pre-commercial) and greater than 8" DBH but generally under 18" DBH (commercial size), on up to 2,480 acres. The potential area for treatment comprises about 3 percent of the Elk Creek Watershed. There are potentially 466 acres of thinning in trees greater than 8" DBH for LSR habitat restoration, 134 acres of riparian reserve thinning in trees greater than 8" DBH, and 793 acres of thinning in areas containing ponderosa pine. The areas in Riparian Reserves would have severed trees retained for coarse woody material on-site or placed in streams for structural diversity in the streams. The thinning in LSR habitat would retain coarse woody debris levels suggested by the LSRA of approximately 28 trees per acre (tpa), 70+ years of age. Thinning would increase late-successional characteristics such as increased tree diameter growth, increased live crown ratios, percent of live intermediate level trees, and increased shrub cover in stands when compared to unthinned stands (Bailey 1996, 91-96). This area would achieve late-successional characteristics quicker than would occur if the stands were not thinned.

Tree planting would occur on up to 2,152 acres of BLM-administered land in the high and moderate burn severity areas. This would decrease the time necessary for these areas to regenerate to tree species, particularly conifers. Hardwoods have begun to sprout from basal clumps. Planting would not occur in burned areas less than 5 acres, and all areas would not be replanted unless stocking falls below 100 tpa. This would increase the spatial variability and species diversity within and between stands of trees, and aid in the early development toward late-successional habitat.

Cumulative Effects

Salvage logging on 247 acres on BLM-administered land would follow the guidance of LSRA for coarse woody material retention for the area. This leaves a level of coarse woody material the LSRA suggests is optimum to maintain long-term site productivity and provide for organisms using this habitat as the area moves toward late-successional conditions. The remaining 1,983 acres of BLM-administered land (2 percent of Elk Creek Watershed), that changed from late or mid-seral stage to early seral stage due to the fire, would not receive salvage harvest and all material would remain on site. Retention of fire-killed trees would add to both future site productivity and the potential for increased high fire severity (Brown, et al. 2003, 2-9).

Pre-commercial thinning has occurred in this watershed on 2,048 acres in the last 10 years. Approximately 1,000 of these acres were damaged or killed in the fire. The remaining 1,050 acres of thinned stands outside the fire area have had accelerated growth on the residual trees. Approximately 3 percent (2,500 acres) of the watershed would have an increase in the growth rate on conifers in stands as a result of the proposed thinning in young stands. Thinning increases the diameter growth rates, live crown ratios, percent of live intermediate level trees, and shrub cover in stands when compared to unthinned stands (Bailey 1996, 91-96). This would potentially reduce the time needed for those areas to become late-successional habitat.

The areas burned with high or moderate severity would be replanted on BLM-administered land. It is likely most of the acres harvested on industrial forest land will be replanted also. This would help reduce the time needed for reforestation processes to occur. Replanting on BLM-

administered lands would not occur until stocking falls below 100 conifers per acre. Replanting on private land would likely be variable. This would add to the variability of tree growth rates and stand complexity, desirable for late-successional characteristics.

Effects of Alternative D on Late-Successional Habitat

Salvage

Direct and Indirect Effects

Alternative D would remove up to 820 acres of fire-killed trees within the fire perimeter. This constitutes approximately 1 percent of the Elk Creek Watershed.. This alternative includes the high and moderate burn severity areas greater than 10 acres in size. This would retain snag and coarse woody debris levels suggested by the DecAID Wood Advisor in the 50-80% range (6.2% ground cover) for PSME plant series and the 80% range (3.6% ground cover) in the ABCO series. These areas would retain the equivalent of 8 snags per acre in the PSME plant series and 17 snags per acre in the ABCO series. The snags would be concentrated in areas outside of the harvest units and would receive no harvest. Approximately 1,766 acres of late and mid-seral stands that received stand-replacement fire would have no harvest and all the material would be retained.

Restoration

Direct and Indirect Effects

Effects from restoration actions under Alternative D would be the same as those described under Alternative C.

Cumulative Effects

Salvage logging on 820 acres (1 percent of the Elk Creek Watershed) would remove coarse woody material from those sites. The remaining 1,060 acres that changed from late seral stage to early seral stage, and the 350 acres that changed from mid-seral to early seral stage (2 percent of the Elk Creek Watershed) would not receive salvage harvest and all material would remain on-site.

Salvage logging on 820 acres on BLM-administered land and thinning in the Late-Successional Reserve would follow the guidance of the DecAID Wood Advisor (Marcot, et al. 2002) for snag and coarse woody material retention levels. The DecAID Wood Advisor suggests this level of retention would be adequate to maintain long-term site productivity and provide for organisms that require this habitat as the area moves toward late-successional conditions. A slight reduction in potential for future high fire severity would result from increased salvage.

Pre-commercial thinning has occurred in this watershed on 2,048 acres in the last 10 years. Approximately 1,000 of these acres were damaged or killed in the fire. The remaining 1,050 acres of thinned stands outside the fire area have had accelerated growth on the residual trees. Approximately 3 percent (2,500 acres) of the watershed would have an increase in the growth rate on conifers in stands as a result of the proposed thinning in young stands. Thinning increases the diameter growth rates, live crown ratios, percent of live intermediate level trees, and shrub cover in stands when compared to unthinned stands (Bailey 1996, 91-96). This would potentially reduce the time needed for those areas to become late-successional habitat.

The areas burned with high or moderate severity would be replanted on BLM-administered land. It is likely most of the acres harvested on industrial forest land will be replanted also. This would help reduce the time needed for reforestation processes to occur. Replanting on BLM-administered lands would not occur until stocking falls below 100 conifers per acre. Replanting on private land would likely be variable. This would add to the variability of tree growth rates and stand complexity, desirable for late-successional characteristics.

Effects of Alternative E on Late-Successional Habitat

Salvage

Direct and Indirect Effects

Under Alternative E, up to 3,269 acres of fire-killed trees would be removed. Of these, approximately 1,339 acres of low burn severity areas would have salvage of fire-killed trees within live stands when more than 4 snags per acre are present in the stand. This reduces the existing snag level on 2 percent of the watershed on BLM managed land. Harvest on the areas of high and moderate severity would remove most of the fire-killed trees greater than 16", while leaving 6-12 tpa, on 2 percent (1,930 acres) of the Elk Creek Watershed. This alternative follows the guidance given in *Effects of Stand-Replacement Fire and Salvage Logging on Cavity Nesting Bird Community in Eastern Cascades Washington* (Haggard and Gaines 2001). The coarse woody debris levels retained are the minimum amounts required on regeneration harvest units as described in the Medford District RMP Record of Decision (120 linear feet of >16" diameter large end, 16' minimum length piece). However, as in all of the alternatives, the majority of the fire-killed trees less than 16" would be left on-site due to the loss of commercial value by the time of salvage. These would contribute to the coarse woody debris on site.

The coarse woody debris retention level would be less than suggested by the guidance in the LSRA. It is anticipated with inclusion of the unsalvaged trees 16" and less it would meet snag and CWD levels for DecAID Wood Advisor at the 30-50% management level. It is unknown what effect this level of coarse woody retention would have on long-term site productivity, soil replenishment, and nutrient cycling. Large

material (>30" diameter) would have greater value for future coarse woody needs than an equal amount of smaller woody material (<16" diameter) retained on-site. “The question of how many trees to leave to sustain soil quality is not easily answered at present and will require further research on functions of large dead wood. Yet retaining trees on site as future source of large woody debris must be a major component of sustainable forest management.” (Aber, et al. 2000, 5). A reduction in potential for future high fire severity would result from removal of over 3,000 acres of fire-killed trees.

Restoration

Direct and Indirect Effects

Alternative E includes the highest levels of restoration activities planned. This includes thinning of conifers less than 8" DBH (pre-commercial), and greater than 8" DBH but generally less than 18" DBH (commercial size), on up to 5,033 acres. There are potentially 876 acres of thinning in trees greater than 8" DBH for LSR habitat restoration, 613 acres of riparian reserve thinning in trees greater than 8" DBH, and 1,849 acres of thinning in areas containing ponderosa pine. No harvest would occur until coarse woody debris retention levels are met using the DecAID Wood Advisor. The areas in Riparian Reserves, which constitute up to 613 acres, would have severed trees retained for coarse woody material on-site or placed in streams for structural diversity in the streams. This would amount to approximately 2 percent ground cover for stands in the “medium” size range of 10-19" (approximately 17 tpa of size 15" DBH by 60' in height).

The LSR thinning could leave up to 17 tpa on the ground. All of the non-reserved trees in the riparian thinning areas would be left as downed wood. However, no more than 20 tons of downed trees would be severed in the riparian areas, so the remaining trees over that amount (approximately 25, 16" DBH trees) would be girdled and left standing. The potential area for treatment comprises about 6 percent (5,033 acres) of the Elk Creek Watershed. Thinning would increase late-successional characteristics such as increased tree diameter growth, increased live crown ratios, percent of live intermediate level trees, and increased shrub cover in stands when compared to unthinned stands. Residual trees would also have greater retention of limbs and more characteristic of older trees. The stands in these treated areas have the potential to achieve late-successional characteristics quicker than would occur if the stands were not thinned. This alternative treats the greatest number of acres of early and mid-seral stands to enhance late-successional habitat.

Effects of conifer reforestation would be the same as those described under Alternative A.

Cumulative Effects

Salvage logging on 1,930 acres and selective salvage of fire-killed trees on another 1,339 acres would remove coarse woody material from those sites. The remaining 300 acres that changed from late or mid-seral stage to early seral stage would not receive salvage harvest and all material would remain on site. It is unknown what effect this level of coarse woody retention would have on long-term site productivity, soil replenishment, and nutrient cycling, but it is lower than levels suggested by the LSRA.

The effects of pre-commercial thinning and reforestation would be the same as those described under Alternative C.

Effects of Alternative F on Late-Successional Habitat

Salvage

Direct and Indirect Effects

Under Alternative F, up to 213 acres of fire-killed trees would be removed. This accounts for less than 1 percent of the Elk Creek Watershed. Areas of fire-killed trees between 2 and 10 acres in size would be harvested, leaving a 2-acre patch of standing fire-killed trees for snags and coarse woody debris. Areas of fire-killed trees greater than 10 acres would not be harvested, leaving all the fire-killed trees in those areas. The amounts of coarse woody debris remaining on-site in these areas exceed the amounts suggested by the LSRA and DecAID Wood Advisor as typical levels of coarse woody debris in these forest types. It also exceeds coarse woody retention levels described in the Medford District RMP for regeneration harvests on Matrix land and in *Managing Coarse Woody Debris in Forests of the Rocky Mountains* (Graham, et al. 1994). Coarse woody debris retention for long-term site productivity and late-successional habitat would not be altered. Retention of fire-killed trees would add to both future site maintenance and potential for increased high fire severity (Brown, et al. 2003, 2-9).

Restoration

Direct and Indirect Effects

Tree planting is the only restoration activity planned under this alternative. Riparian areas and areas with slopes greater than 65 percent would be planted. This would occur on up to 1,045 acres. Planting would decrease the time necessary for these areas to regenerate to tree species, particularly conifers. These areas would not be replanted unless stocking falls below 100 tpa. This would allow for spatial variability and varied growth rates on individual trees. Burned areas outside of riparian areas and slopes less than 65 percent would be allowed to reforest naturally. Natural reforestation would potentially take longer and be less consistent than in alternatives where planting occurs. This is especially true in large areas where entire stands of trees were killed and seed sources for trees are long distances away. The variability of tree spacing would be preferred in the LSR; however large parcels (over 10 acres) without reforestation or with delayed

reforestation would be detrimental to late-successional habitat formation.

No restoration activities would occur outside of the fire area in this alternative. Thinnings would reduce the time required for existing early and mid-seral forests to develop late-successional characteristics. Because thinning would not occur on up to 5,033 acres within the watershed, late-successional development would be delayed.The densest stands would eventually lose the opportunity to develop the branching patterns of old-growth conifers on individual trees as they continued to develop as a very dense stand. Growth rates would be reduced by an average of 36 percent, compared to similar thinned stands in both upland and riparian areas (Bailey 1996, 92).

Cumulative Effects

Salvage logging on 213 acres would remove coarse woody material from those sites. This alternative retains 2 acres of fire-killed trees for every 10 acres harvested and also retains all trees on fire-killed areas greater than 10 acres in size. While the exact levels of coarse woody debris necessary to ensure long-term site productivity and sustainable forest management for late-successional habitat is not known, this alternative leaves levels in the watershed exceeding recommendations from present guidelines.

The effects of pre-commercial thinning would be the same as those described under Alternative C.

Tree planting is the only restoration activity planned under this alternative. Riparian areas and areas with slopes greater than 65 percent would be planted. This would occur on up to 1,045 acres. This would decrease the time necessary for these areas to regenerate to tree species, particularly conifers. Replanting on these areas would not occur unless stocking falls below 100 tpa. Burned areas outside of riparian areas and slopes less than 65 percent would be allowed to reforest naturally. It is likely that most all of the acres harvested on private industrial land would be replanted. Replanting promotes reforestation, however natural regeneration allows for greater variability in stocking and individual tree growth rates and characteristics. Large areas (greater than 10 acres) without reforestation would be detrimental to late-successional habitat development and the Medford District RMP makes the assumption industrial forest land would not be available as late-successional habitat due to harvest regimes. Lack of tree planting on burned areas outside of riparian areas and slopes less than 65 percent would be risky and could be detrimental to promotion of late-successional habitat.

Effects of Alternative G (Preferred Alternative) on Late-Successional Habitat

Salvage

Direct and Indirect Effects

Alternative G would remove up to 961 acres of fire-killed trees within the fire perimeter, 679 acres in the project salvage and 282 acres in the research project. This constitutes approximately 1 percent of the Elk Creek Watershed. This alternative would include a research project developed by Oregon State University. It involves designating 12 areas, each 30-acres or greater, that received high or moderate burn severity. They would have levels of harvest ranging from all trees harvested (except 6 snags per acre) to none of the trees harvested in those areas. Total area considered would be up to 534 acres with 282 acres harvested for the research project.

This alternative includes the high and moderate burn severity areas greater than 10 acres in size not chosen as research units. These areas would retain the equivalent of 8 snags per acre in the PSME plant series and 12 snags per acre in the ABCO series. The snags would be concentrated in portions of the units that receive no harvest. Approximately 1,004 acres would be included as harvest units, with 679 acres receiving harvest of all fire-killed trees and the remaining 325 acres retaining all trees, accounting for the 8-12 snags per acre. This would retain snag and coarse woody debris levels suggested by the DecAID Wood Advisor in the 30-50 percent range for PSME plant series and 50-80 percent range in the ABCO series. There were approximately 2,230 acres of late seral stage forest that burned at hot or moderate severity. Approximately 1,269 acres of late and mid-seral forest that received stand-replacement fire would retain all of the fire-killed trees for wildlife habitat and ecosystem diversity and productivity (Rose, et al. 2002, 580).

On the areas included in the research alternative, coarse woody debris retention varies by 3 different treatments with approximately 120 acres having 6 trees per acre reserved and approximately 120 acres having all of the coarse wood reserved. The 120 acres with 6 trees per acre retained would have the minimum snags and coarse woody debris for wildlife and ecosystem processes (Ohmann 2002) on those acres, as suggested by the DecAID Wood Advisor.

Restoration

Direct and Indirect Effects

Except as described below, the restoration effect under Alternative G would be the same as those described under Alternative C.

A research reforestation plan would be included as part of this project. This study would be designed by Oregon State University in conjunction with the BLM. Approximately 75-90 acres would be planted with a mix of species at a variety

of densities. Planting would take place on high and moderate burn severity areas. This research study could be included in Alternatives B through F, with variations by alternative. Effects of the different treatments would be compared and evaluated as outlined in the research proposal. The areas included in this research plan are all areas that are part of the reforestation proposals in all of the alternatives. The effects of this proposal would be included in the effects of the reforestation proposals, and no new effects on the watershed would occur due to the reforestation research project.

Cumulative Effects

Salvage logging on 961 acres (1 percent of the Elk Creek Watershed) would remove coarse woody material from those sites. The remaining 1,269 acres that changed from late and mid-seral stage to early seral stage would not receive salvage harvest and all material would remain on-site. A landscape approach was used in determining the snags and CWD levels. Snag and CWD levels would be applied across all stand-replacement units on BLM land. This alternative would leave snag and coarse woody debris retention levels suggested by the DecAID Wood Advisor in the 30-50% range for PSME plant series and 50-80% range in the ABCO series.

On the approximately 282 acres included in the research portion of this alternative, coarse woody debris retention varies by 3 different treatments with approximately 147 acres having 6 trees per acre reserved and approximately 196 acres having all the coarse wood reserved. The 147 acres with 6 trees per acre retained would have the minimum snags and coarse woody debris for wildlife and ecosystem processes (Ohmann 2002) on those acres, as suggested by the DecAID Wood Advisor.

"The question of how many trees to leave to sustain soil quality is not easily answered at present and will require further research on functions of large dead wood. Yet retaining trees on site as future source of large woody debris must be a major component of sustainable forest management." (Aber, et al. 2000, 5). While the question of what level of snags and down wood is needed to maintain natural processes, such as long-term site productivity, is not completely answered, this alternative retains the levels recommended by the DecAID Wood Advisor at the 30-50% tolerance level for PSME plant series and the 50-80% tolerance level in the ABCO series for "wildlife and ecosystem processes" (Ohmann 2002).

This alternative would also retain all of the late seral stage fire-killed trees on 919 acres that received a stand-replacement burn. Fire-killed trees of all sizes would fall down over time, with the smallest starting to come down within 5 years and some of the largest standing for decades. Reforestation and associated treatments proposed in combination with this level of snag and coarse woody debris retention would help produce future late-successional habitat. Some reduction in the potential for increased fire severity would result from the removal of 961 acres of fire-killed trees.

There are approximately 1,188 acres considered for roadside hazard salvage, which includes a 200' strip of land on both sides of roads within the fire perimeter. Very little salvage would occur below the roads, which constitutes half of the acreage. The portion above the road would have scattered trees removed, except the portions that fall within the boundaries of area salvage harvest units, which are already considered in those unit acres analyzed. The actual effected acres that have hazard tree removal would be very scattered over the entire fire area and have little impact on long-term late-successional habitat due to the small amount of land impacted and the close proximity of these acres to roads.

The effects of thinning and reforestation would be the same as those described under Alternative C

3.6.3.2 Insects

Effects Common to all Alternatives

Salvage

Direct and Indirect Effects

The early seral stage acreage across all plant series was increased by 2,230 acres. Most of these acres have standing and downed fire-killed trees. The majority of these trees are Douglas-fir. The Douglas-fir beetle and flatheaded fir borer will be the primary vector in Douglas-fir. In all alternatives, only a portion of fire-killed trees would be removed. None of the alternatives harvest green, weakened trees, which are the most susceptible hosts for Douglas-fir beetle. However, recently dead trees can also be used by the beetles to a lesser extent (Ragenovich 1988, 14-15; Goheen 2003). Douglas-fir beetles prefer recently downed trees, but they will attack weakened or dead Douglas-fir, and the next generation of emerging adult Douglas-fir beetles will attack adjacent green trees. Douglas-fir beetles do not do well in healthy, standing, green trees and the outbreak should be short-lived. Trees severely scorched or killed are less suitable for beetle development than weakened or downed green trees, as the cambium is often too damaged from heat (Ragenovich 1988, 14-15). Salvaging dead trees would only have limited value in reducing Douglas-fir beetle outbreaks.

The flatheaded fir borer will infest dead and weakened Douglas-fir and their attacks will continue for several years, as long as the wood remains sound (Ragenovich 1988, 14-15). These effects would more likely be altered by alternative.

The western pine beetle in ponderosa pine and the mountain pine beetle in ponderosa and sugar pine would be the primary insects to infest pines in the fire area vicinity

(Ragenovich 1988, 14-15, Goheen 2003). Pine comprises a much smaller portion of the fire area and adjacent green stands. The majority of the areas with pine present are in the south portion of the fire perimeter on south aspects and in adjacent green stands in the southern portion of the watershed. Both species of beetles prefer weakened fire-damaged trees to dead trees, standing or downed. It is possible beetle populations will build in these stands, but it would likely be limited by the low amount of pine present and the limited amount of pine weakened in the fire area.

Salvage could potentially occur on up to 6,000 acres of industrial forest land within the fire area. This would remove fire-killed trees which are marginal habitat for Douglas-fir beetle and would likely include fire-damaged trees which provide the best habitat for beetle infestation. Salvage on these lands reduces the potential for beetle outbreaks in these areas and adjacent green stands. The flatheaded fir borer populations and potential increase in populations due to habitat in fire-killed trees would be reduced due to the removal of dead and dying Douglas-fir, the primary habitat for the fir borers. Unlike Douglas-fir beetle, the flatheaded fir borer attacks would continue as long as the dead wood remains sound (Ragenovich 1988).

Salvage of roadside hazard trees along BLM managed roads, would occur in all alternatives except Alternatives A and B. These areas would have limited removal of fire-killed trees, primarily above the road. The areas that received high or moderate burn severity would have the majority of the hazard tree removal. These areas range from approximately 50 acres to approximately 200 acres. This includes areas 200 feet above and below the road, however salvage below the road would involve minor amounts. The overall impact would likely be to less than 100 acres of BLM-administered land over the entire fire area. The impacts would be negligible on bark beetle and wood borer populations due to the small amount of area of fire-killed trees harvested.

Restoration

Direct and Indirect Effects

No salvaging would take place outside the fire perimeter. Weakened trees adjacent to the fire perimeter would be susceptible to insect damage. Removal of stressed or suppressed trees would likely reduce some of the host trees for insect brooding for both Douglas-fir beetle, and the mountain and western pine beetles. Salvaging only dead trees within the fire would have limited value in reducing beetle outbreaks in weakened trees outside the fire perimeter.

Effects of Alternative A (No Action) on Insects

Salvage

Direct and Indirect Effects

There is no proposed salvage under Alternative A. Retention of all of the fire-killed trees would allow some increase in beetle populations. Trees severely scorched or killed may be unsuitable for beetle development, as the cambium is often too damaged from heat (Ragenovich 1988, 14-15). In green trees downed due to wind events, for every two to four downed trees infested, beetles will attack one green standing tree (Hostetler and Ross 1996, 3-4). However, this does not imply fire-killed trees will act as similar hosts for Douglas-fir beetles. Fire-killed trees generally are poorer hosts for beetle infestation than weakened trees, and only recently killed trees provide that habitat, with the main attack occurring in the spring or summer of the year following the fire (Ragenovich 1988, 14-15). “The likelihood of attack by primary bark beetles is low with light needle kill, increases with moderate to heavy defoliation and declines with complete needle mortality and the concomitant fire kill.” (Weatherby 2001, 2).

It is likely an increase in Douglas-fir beetle, and western and mountain pine beetle populations would occur due to the fire. Lack of salvage of dead trees would allow for some increased beetle populations, but the majority of the beetle population would increase by infesting the damaged standing green conifers. In most cases where observations have been made on past southwest Oregon wildfires, insect populations have not built up to any significant amount in stands outside of the wildfires. It is likely fire-damaged trees will be infested and killed by insects for at least four years after the fire (Goheen 2003). Infestations of conifer stands by both Douglas-fir beetle on Douglas-fir, and western pine and mountain pine beetle on pines would likely be limited to isolated stands adjacent to or within the fire perimeter.

The flatheaded fir borer will infest dead and weakened Douglas-fir, and their attacks would continue for several years, as long as the wood remains sound. These populations would increase as long as there is a source of sound dead wood. Lack of salvage would provide more habitat for this species of insect. The infestation would increase, infest a large portion of the dead trees, and remain as long as sound, downed wood is available.

Restoration

Direct and Indirect Effects

Conifer stands adjacent to burned areas inside the fire would likely have some increase in bark beetle infestation in trees already weakened or suppressed. It is unlikely extensive areas of healthy green trees would be infested and killed by bark beetles. “Populations can concentrate and build up in weakened trees and the next generation of emerging adults would attack adjacent green trees the following spring. However, Douglas-fir beetles do not do well in standing, green trees and the outbreak would be short-lived.” (Ragenovich 1988, 14-15). Some local infestations would occur due to a temporary buildup of bark beetle populations, both in pine and Douglas-fir. Elevated levels of beetle-

caused mortality have been observed within a 2-3 year period following a fire but were confined to damaged trees (Weatherby 2001, 8). It is unlikely a large outbreak would occur, and localized infestations of green stands adjacent to the fire would be the affected areas.

No thinning is planned in this alternative, so there would be no increase in habitat in the form of newly-severed downed trees. The lack of thinning would allow suppressed and weakened trees to remain on-site as hosts for bark beetles. Both conditions can contribute to bark beetle population increases. It is unclear whether the benefits of thinning on reducing insect populations would be offset by the habitat created with the retention of severed wood for coarse woody material. It would depend on which action creates the most habitat by generating the greatest volume of wood, with downed wood being preferred as breeding habitat for Douglas-fir beetles.

Cumulative Effects

The increase in bark beetle populations would be localized to areas adjacent to the fire perimeter, particularly in weakened or suppressed green conifers. The increase in bark beetle activity would last at least four years within the fire area (Goheen 2003). Up to 6,000 acres of the industrial forest land within the fire perimeter has been salvaged or is planned for salvage operations within the first two years after the fire. This includes many fire-damaged and weakened trees, the primary host for bark beetles, along with fire-killed trees. This would reduce the host medium for bark beetle populations on that portion of the watershed. After the initial increase in bark beetle activity on fire-killed trees in the first year after the fire, the beetle activity would shift to weakened trees inside the fire perimeter and outside the perimeter within the Elk Creek Watershed. The population should slowly decline in following years as available weakened trees are killed and the number of fire-weakened host trees is reduced.

The affect of the salvage operations on flatheaded wood borer populations would be to reduce the habitat for these insects, as they will infest dead and weakened Douglas-fir. Their attacks will continue for several years, as long as the wood remains sound (Ragenovich 1988, 14-15). The removal of fire-killed trees reduces the habitat and these insects would not increase in numbers on harvested land to any measurable degree.

Future harvest would occur on industrial forest lands within the watershed as mortality occurs on remaining green weakened conifers. There are no plans, at this time, to harvest on BLM-administered lands in the Elk Creek Watershed, beyond what is being proposed in this EIS. This alternative does not remove any of the fire-killed trees. Harvest of subsequent mortality in the conifers on BLM would not be considered, unless an excessively high mortality of green trees occurs. This alternative leaves the greatest amount of habitat for bark beetles and particularly flatheaded wood borers since they can infest dead wood until the wood is no longer sound. Bark beetle populations would have some increase on BLM fire-killed areas and adjacent green stands. A greater increase in the fire-killed areas would occur with flatheaded wood borer populations because their preferred medium is dead trees with sound wood.

Effects of Alternative B on Insects

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage activities are planned. Effects on insects would be similar to Alternative A.

Restoration

Direct and Indirect Effects

Low levels of restoration activities are planned in this alternative. No activities are planned in stands with trees larger than 8" DBH. Green trees less than 8" DBH would be felled during thinning operations. The majority of these trees would be piled and burned, removing most of the potential habitat for bark beetles. Tree stems are seldom infested with Douglas-fir beetles in top diameters greater than 6 or 8 inches (USDA 1996, 1-4). Any trees not piled and burned would be less than 8" DBH and would be poor habitat for bark beetles.

Cumulative Effects

Effects on insects would be similar to Alternative A.

Effects of Alternative C on Insects

Salvage

Direct and Indirect Effects

Under Alternative C, retention of fire-killed trees would allow some increase in beetle populations. Fire-killed trees would be removed on up to 247 acres within the fire perimeter. This would reduce the amount of habitat for both bark beetles and wood borers on those acres. Fire-killed trees are only marginal habitat for Douglas-fir, mountain pine, and western pine beetles. Trees severely scorched or killed may be unsuitable for beetle development, as the cambium is often too damaged from heat (Ragenovich 1988, 14-15). “The likelihood of attack by primary bark beetles is low with light needle kill, increases with moderate to heavy defoliation and declines with complete needle mortality and the concomitant fire kill.” “Douglas-fir beetle attacks increased with the degree of crown and cambial injury, but abruptly declined in the completely defoliated trees.” (Weatherby 2001, 2 and 8). Fire-damaged trees, the preferred hosts for bark beetles, would remain on-site. The removal of 247 acres of fire-killed trees would slightly reduce the increase in bark beetle populations following the fire.

Removal of 247 acres of fire-killed trees would have a slightly greater impact on the flat-headed fir borer populations, as they most often attack and bore into the sapwood and heartwood of trees already killed by the fire (Ragenovich 1988). These populations will stay at higher than normal levels as long as the wood remains sound on the dead trees. There would be approximately 1,983 acres of fire-killed trees in the high and moderate burn severity remaining on-site that are mid- or late seral stage. These trees would potentially be good habitat for flat-headed fir borer populations. Removal of 247 acres of fire-killed trees would reduce fir borer habitat on the total Elk Creek Watershed by less than 1 percent.

Restoration

Direct and Indirect Effects

Moderate levels of restoration activities are planned in this alternative. These include thinning of conifers less than 8" DBH (pre-commercial), and greater than 8" DBH but generally less than 18" DBH (commercial size). The pre-commercial thinning would sever trees less than 8" DBH, which are poor habitat for bark beetles. Severed trees would be piled and burned. Commercial thinning plans would leave coarse woody debris levels suggested by the LSRA of approximately 28 tpa, 70+ years of age. These downed green trees would be habitat for Douglas-fir beetles and flatheaded fir borer. Some increase in the population of the beetles and borers would occur as these trees become brooding area for beetles. Weakened live trees can be infested with Douglas-fir beetles at a rate of up to 60 percent of the number of downed infested trees in an outbreak (Hostetler and Ross 1996, 3-4).

There are potentially 466 acres of thinning in trees greater than 8" DBH for LSR habitat restoration, and 134 acres of riparian reserve thinning in trees greater than 8" DBH. The LSR thinning could leave up to 28 tpa on the ground, and all of the non-reserved trees in the riparian areas would be left as downed wood. No more than 20 tons of downed trees would be severed, so the remaining trees over that amount (approximately 25, 16" DBH trees) in the riparian areas would be girdled and left standing. These trees would still be breeding habitat for bark beetles and wood borers. The distance from the fire perimeter and general health of the residual trees in the thinned stand would reduce the infestation rate of the bark beetles and wood borers. Overall, there would potentially be a slight increase in the Douglas-fir beetle population and wood borer population due to restoration commercial thinning coarse woody debris retention. The populations would be isolated, short-lived, and concentrated in trees adjacent to the thinning operations. Removal of suppressed and weakened trees during thinning would reduce habitat for bark beetles and wood borers. These trees would be marginal habitat as Douglas-fir beetles prefer downed wood and pine beetles prefer larger wood for breeding habitat.

There are potentially 777 acres (1 percent of the Elk Creek Watershed) of thinning in areas containing ponderosa pine. These areas are susceptible to mountain and western pine beetle, however only a small portion of these stands would be treated at a given time. The removal of severed trees from the pine thinning operation would reduce a potential increase in pine beetle populations. There would be little increase in pine beetle populations due to the removal of most severed trees.

Cumulative Effects

Cumulative effects would be similar to Alternative A with some reductions in bark beetle and fir borer activity in the fire perimeter and immediate vicinity. The removal of 247 acres of fire-killed trees would reduce the habitat within the entire Elk Creek Watershed across all land ownerships by less than 1 percents. The removal of these trees would potentially reduce insect activity in adjacent patches of green weakened trees.

The removal of 6,000 acres (7 percent of the watershed) of fire-killed and damaged trees on industrial forest land would reduce any beetle outbreak on those lands and adjacent areas. This removal would directly reduce the habitat for the flatheaded wood borer. They will infest dead and weakened Douglas-fir, and their attacks will continue for several years, as long as the wood remains sound (Ragenovich 1988, 14-15). The retention of 1,983 acres of fire-killed late and mid-seral trees on BLM-administered land would provide habitat for the wood borers and these dead trees would likely be infested for as long as the wood remains sound and on-site, perhaps up to 10 years.

The restoration thinning and subsequent retention of severed trees for coarse woody debris would potentially increase habitat for bark beetles, particularly Douglas-fir beetle. This would occur on stands adjacent to the fire area. Removal of downed trees after thinning would reduce the suitable habitat for reproduction of Douglas-fir and Western and Mountain pine beetles. In green trees downed due to wind events, for every two to four downed trees infested, beetles would attack one green standing tree (Hostetler 1996, 3-4). The potential would be present for this level of beetle activity in downed thinned trees.

Up to 466 acres of stands would be treated for LSR habitat improvement, 134 acres of riparian thinning, and 777 acres of pine thinning in trees over 8" DBH. However, treatments would occur over time and only portions would be treated in a given year. This area is potentially 2 percent of the watershed, but the potential for host trees for beetles is scattered within these acres. The downed thinned trees would be marginal habitat as they are generally less than 16" DBH and not the larger sizes the bark beetles prefer. The majority of the live stands within this area would be marginal habitat for beetles because they are not in a weakened condition and are not of large size. A small increase in Douglas-fir beetle

populations is possible in thinned stands due to the retention of severed trees for coarse woody debris. It would likely be localized and confined to just areas that have thinning operations. It would be hard to detect on the scale of the Elk Creek Watershed.

This alternative has a slight benefit in reducing insect habitat in fire-killed trees but allows some increase in habitat due to thinning residue. The benefits of thinning suppressed, weakened trees, which provide habitat for bark beetles, may offset the increase in habitat due to retained coarse woody material from the thinning operations. However, the newly-severed downed wood from thinning would provide a more desirable habitat for the Douglas-fir beetle than standing trees.

Effects of Alternative D on Insects

Salvage

Direct and Indirect Effects

Under Alternative D, up to 820 acres of fire-killed trees within the fire perimeter would be removed. This would reduce the amount of habitat for both bark beetles and wood borers on those acres. Fire-killed trees are only marginal habitat for Douglas-fir, mountain pine, and western pine beetles. Trees severely scorched or killed may be unsuitable for beetle development, as the cambium is often too damaged from heat (Ragenovich 1988, 14-15). “The likelihood of attack by primary bark beetles is low with light needle kill, increases with moderate to heavy defoliation and declines with complete needle mortality and the concomitant fire kill” (Weatherby 2001, 2, 8). Fire-damaged trees would remain on site. These are the preferred hosts for bark beetles. Removal of 820 acres of fire-killed trees would likely have a minor impact on the Douglas-fir beetle population by reducing the number of fire-killed trees on-site; however, this is only marginal habitat for beetle reproduction.

Removal of 820 acres of fire-killed trees would have a greater impact on the flat-headed fir borer populations, as they most often attack and bore into the sapwood and heartwood of trees already killed by the fire (Ragenovich 1988, 14-15) and these trees would no longer be available as habitat. These populations would increase on those areas not salvaged, approximately 63% (1,410 acres) of the high and moderate burn severity areas containing late or mid-seral fire-killed trees, but would be reduced on 820 acres harvested.

Restoration

Direct and Indirect Effects

The effects of restoration on insect populations would be similar to those described under Alternative C. There would be a slightly reduced amount of downed wood after restoration thinning, compared to Alternative C, so there is a potential for a slightly reduced wood borer and bark beetle population.

Cumulative Effects

The removal of 820 acres of fire-killed trees would reduce the habitat on BLM-administered land by 37 percent within the area of the fire-killed mid- and late seral stands. Within the entire Elk Creek Watershed across all land ownerships, this accounts for approximately 1 percent of the 85,424 acres. The removal of 6,000 acres (7 percent of the watershed) of fire-killed and damaged trees on private industrial land would reduce any beetle outbreak on those lands and adjacent areas. This removal would directly reduce the habitat for flatheaded wood borers. They infest dead and weakened Douglas-fir and their attacks will continue for several years, as long as the wood remains sound (Ragenovich 1988, 14-15). This alternative would not remove individual fire-killed trees scattered around the low burn severity areas.

The restoration thinning, and subsequent retention of severed trees for coarse woody debris, would potentially increase habitat for bark beetles, particularly Douglas-fir beetle. This would occur on stands adjacent to the fire area. Removal of downed trees after thinning would reduce the suitable habitat for reproduction of Douglas-fir, and Western and Mountain pine beetles. In green trees downed due to wind events, for every two to four downed trees infested, beetles would attack one green standing tree (Hostetler and Ross 1996, 3-4). The potential would be present for this level of beetle activity in downed thinned trees. There is the potential for a slight increase in wood borer populations after LSR thinning due to a slightly greater amount of downed wood retained.

Up to 466 acres of stands would be treated for LSR habitat improvement, 134 acres of riparian thinning, and 777 acres of pine thinning in trees over 8" DBH. However they would occur over time and only portions would be treated in a given year. This area is potentially 2 percent of the watershed, but host trees for beetles are scattered within these acres. The downed thinned trees would be marginal habitat as they are generally less than 16" DBH and not the larger sizes the bark beetles prefer. The majority of the live stands within this area would be marginal habitat for beetles as they are not in a weakened condition and are not of large size. A small increase in Douglas-fir beetle populations is possible in thinned stands due to the retention of severed trees for coarse woody debris. It would likely be localized and confined to just areas with thinning operations. There would be a slightly reduced amount of downed wood after restoration thinning, compared to Alternative C, so there is a potential for a slightly reduced wood borer and bark beetle population.
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Effects of Alternative E on Insects

Salvage

Direct and Indirect Effects

Under Alternative E, fire-killed trees on 1,930 acres would be

removed. This would reduce the amount of habitat for both bark beetles and wood borers on those acres. Fire-killed trees are only marginal habitat for Douglas-fir, mountain pine, and western pine beetles. Trees severely scorched or killed may be unsuitable for beetle development, as the cambium is often too damaged from heat (Ragenovich 1988). “The likelihood of attack by primary bark beetles is low with light needle kill, increases with moderate to heavy defoliation and declines with complete needle mortality and the concomitant fire kill.” “Douglas-fir beetle attacks increased with the degree of crown and cambial injury, but abruptly declined in the completely defoliated trees” (Weatherby 2001, 2, 8). Fire-damaged trees would remain on-site. These are the preferred hosts for bark beetles. Removal of 1,930 acres of fire-killed trees would likely have a minor impact on the Douglas-fir beetle population by reducing the number of fire-killed trees on-site, however this is only marginal habitat for beetle reproduction.

Removal of 1,930 acres of fire-killed trees would have a greater impact on the flat-headed fir borer populations, as they most often attack and bore into the sapwood and heartwood of trees already killed by the fire (Ragenovich 1988, 14-15). These populations would not be allowed to build up as most of the fire-killed trees would be removed on over 80 percent of the BLM-administered acres in the high or moderate burn severity areas containing late or mid-seral fire-killed trees.

Selective salvage harvest of individual fire-killed trees within low burn severity areas on another 1,339 acres would further reduce the habitat for bark beetles and flatheaded wood borers. The close proximity of these fire-killed trees would allow the removal of these trees to have some beneficial impact on the reduction of bark beetle populations and their effects on adjacent fire damaged trees.

Restoration

Direct and Indirect Effects

This alternative includes the highest levels of restoration activities planned. This includes thinning of conifers less than 8" DBH (pre-commercial), and greater than 8" DBH but generally under 18" DBH (commercial size) on up to 5,033 acres (1,978 LSR habitat) (2,005 pine restoration) (1,050 Riparian Reserves). There are potentially 876 acres of thinning in trees greater than 8" DBH for LSR habitat restoration, and 613 acres of Riparian Reserve thinning in trees greater than 8" DBH. LSR habitat restoration thinning plans would leave coarse woody debris levels suggested by the DecAID Wood Advisor for Southwest Oregon. This would amount to approximately 2 percent ground cover for stands in the “medium” size range of 10-19" (approximately 17 tpa of size 15" DBH by 60' in height). The LSR thinning could leave up to 17 tpa on the ground, and all of the non-reserved trees in the riparian thinning areas would be left as downed wood. No more than 20 tons of downed trees would be severed in the riparian areas, so the remaining trees over that amount (approximately 25, 16" DBH trees) would be girdled and left standing.

The restoration thinnings and subsequent retention of severed trees for coarse woody debris would potentially increase habitat for bark beetles, particularly Douglas-fir beetle. This would occur on stands adjacent to the fire area. The severed green trees would be good habitat for Douglas-fir beetles and flatheaded fir borers. Some increase in the population of the beetles and borers would likely occur as these trees become brooding area for beetles. Weakened live trees can be infested with Douglas-fir beetles at a rate of up to 60 percent of the number of downed infested trees in an outbreak (Hostetler 1996, 3-4). Potentially 25 tpa could be retained as downed wood in riparian areas. It is possible up to 15 standing tpa could be infested with Douglas-fir beetles from insects in the downed trees. All of the areas planned for thinning would be completed over time, so any increase in beetle or wood borer populations would be limited by the acreage treated, and outbreaks would likely be limited to thinned areas.

There are potentially 1,849 acres of pine restoration thinning in trees over 8" DBH. Most of the trees would be removed in these thinnings so the potential increase in habitat for western and mountain pine beetles would be very little. The potential benefit to the health of the residual pines could offset any increased beetle activity in downed woody material.

Cumulative Effects

The removal of 1,930 acres of fire-killed trees would reduce the habitat on BLM-administered land by 88 percent within the acreage of the fire-killed mid- and late seral stands. Within the entire Elk Creek Watershed across all land ownerships, this accounts for less than 1 percent of the 85,424 acres. Selective salvage harvest of individual fire-killed trees within low burn severity areas on another 1,339 acres would further reduce the habitat for bark beetles and flatheaded wood borers. The removal of 6,000 acres (7 percent of the watershed) of fire-killed and damaged trees on industrial forest land would reduce any beetle outbreak on those lands and adjacent areas. The effect of this removal on flatheaded wood borer would directly reduce the habitat for these insects since they will infest dead and weakened Douglas-fir. Their attacks will continue for several years, as long as the wood remains sound (Ragenovich 1988, 14-15). This alternative removes the greatest volume of fire-killed trees and would leave the least amount of dead wood habitat for bark beetles and particularly for flatheaded wood borers.

The restoration thinning and subsequent retention of severed trees for coarse woody debris would potentially increase habitat for bark beetles, particularly Douglas-fir beetle. This would occur on stands adjacent to the fire area. Removal of downed trees after thinning is important to reduce the

suitable habitat for reproduction of Douglas-fir, and Western and Mountain pine beetles. In green trees downed due to wind events, for every two to four downed trees infested, Douglas-fir beetles would attack one green standing tree (Hostetler 1996, 3-4). The potential would be present for this level of beetle activity in downed thinned trees.

There are plans for up to 876 acres of stands to be treated for LSR habitat improvement, 613 acres of riparian thinning, and 1,849 acres of pine thinning in trees over 8" DBH. Treatments would occur over time and only portions would be treated in a given year. This area is 5 percent of the watershed, but the potential for host trees for beetles is scattered within these acres. The majority of the acreage is in pine restoration and most of the severed trees would be removed in these areas. This should have little effect on the western and mountain pine beetle populations. A small increase in Douglas-fir beetle populations would be possible in thinned stands due to the restoration activities. It would likely be localized and confined to just areas with thinning operations.

Alternative E offers the most potential reduction in insect activity in trees within fire-killed areas, and the greatest reduction in potential flatheaded wood borer populations. This alternative treats the greatest amount of area with thinning operations and leaves the greatest overall amount of downed wood from those activities. It also removes the greatest amount of suppressed and weakened trees. The severed, downed trees are the preferred habitat of Douglas-fir beetles. It is likely this alternative allows the greatest potential for insect population growth within those thinned areas, due to the increase of fresh coarse woody debris.

Effects of Alternative F on Insects

Salvage

Direct and Indirect Effects

Retention of fire-killed trees would allow some increase in beetle populations. Under Alternative F, up to 213 acres of fire-killed trees in patches of dead trees between 3 and 10 acres would be removed. Areas of fire-killed trees greater than 10 acres would be retained. Fire-killed trees are only marginal habitat for Douglas-fir, mountain pine, and western pine beetles. Trees severely scorched or killed may be unsuitable for beetle development, as the cambium is often too damaged from heat (Ragenovich 1988, 14-15). “The likelihood of attack by primary bark beetles is low with light needle kill, increases with moderate to heavy defoliation and declines with complete needle mortality and the concomitant fire kill.” “Douglas-fir beetle attacks increased with the degree of crown and cambial injury, but abruptly declined in the completely defoliated trees” (Weatherby 2001, 2, 8). Fire-damaged trees would remain on-site. These are the preferred hosts for bark beetles. The close proximity of the fire-killed trees to adjacent fire-damaged trees would allow the removal of these trees to have more beneficial impact on the reduction of bark beetle and wood borer populations than removing the same amount of trees in the middle of a larger area of fire-killed trees. The removal of 213 acres of fire-killed trees would slightly reduce the increase in bark beetle populations following the fire.

Removal of 213 acres of fire-killed trees would have a slightly greater impact on the flat-headed fir borer populations, as they most often attack and bore into the sapwood and heartwood of trees already killed by the fire (Ragenovich 1988, 14-15). These populations will stay at higher than normal levels as long as the wood remains sound on the dead trees. There would be approximately 2,230 acres of mid- or late seral stage fire-killed trees in the high and moderate burn severity that would not be salvaged. These trees would potentially be good habitat for flat-headed fir borer populations. Removal of 213 acres of fire-killed trees would reduce fir borer habitat on BLM-administered land within late and mid-seral fire-killed stands by approximately 10 percent. The reduction in habitat on the total Elk Creek Watershed on all land allocations (85,424 acres) would be less than 1 percent.

Restoration

Direct and Indirect Effects

No thinning is planned in LSR habitat, riparian reserves, or pine restoration areas in this alternative. Conifer stands adjacent to burned areas inside the fire would likely have some increase in bark beetle infestation in trees already weakened or suppressed. It is unlikely extensive areas of healthy green trees would be infested and killed by bark beetles. “Populations can concentrate and build up in weakened trees and the next generation of emerging adults would attack adjacent green trees the following spring. However, Douglas-fir beetles do not do well in standing green trees and the outbreak would be short-lived.” (Ragenovich 1988, 14-15). Some local infestations would likely occur due to a temporary buildup of bark beetle populations, both in pine and Douglas-fir. Elevated levels of beetle caused mortality have been observed within a two to three year period following a fire but were confined to damaged trees (Weatherby 2001, 8). It is unlikely a large outbreak would occur, and localized infestations of green stands adjacent to the fire would likely be the affected areas. There would be no increase in beetle or wood borer habitat in the form of newly-severed downed trees outside of the fire perimeter, so no increase in bark beetle and wood borer populations due to activities under this alternative outside of the fire perimeter.

Retention of suppressed trees that would not be thinned would occur under this alternative. These trees are potential habitat for bark beetles and wood borers as weakened trees are often attacked when bark beetle and wood borer populations begin to increase after fires or large scale

blowdown. The suppressed trees removed in a thinning tend to be small and less desirable habitat than larger diameter trees for bark beetles (Weatherby 2001, 2, 8). Douglas-fir beetles prefer downed trees, but are not limited to them (Ragenovich 1988, 14-15). Western and mountain pine beetles and wood borers would infest both down and standing trees. Wood borers in particular most often attack trees killed by the fire. It would be very difficult to discern whether the effect of not thinning suppressed trees would have a greater affect on these insect populations than thinning and leaving lesser amounts of downed material which would provide better habitat for bark beetle and wood borer populations.

Cumulative Effects

The removal of 213 acres of fire-killed trees would reduce the habitat by 10 percent within the acreage of potential beetle habitat areas on BLM-administered lands. Within the entire Elk creek Watershed across all land ownerships, this accounts for less than 1 percent of the 85,424 acres. The removal of these trees would potentially reduce insect activity in adjacent patches of green weakened trees.

The lack of thinning in this alternative would retain the weakened and suppressed trees outside the fire perimeter in the watershed. These can be habitat for bark beetles. However, because these trees that would be removed tend to be small diameter trees they are only marginal habitat for bark beetles, so the benefit of thinning to reduce bark beetle populations is limited. No downed wood would be created from thinning, so this type of bark beetle and wood borer habitat would not be increased.

It is likely that future harvest would occur on private industrial lands within the watershed as mortality occurs on remaining green weakened conifers. There are no plans, at this time, to harvest on BLM-administered in the Elk Creek Watershed, beyond what is proposed in this EIS. The harvest on private lands would have the biggest impact on reducing habitat for bark beetles and most wood borers. The removal of 213 acres would also reduce habitat, primarily for wood borers. This alternative would have a slight benefit in reducing bark beetle and wood borer habitat in fire-killed trees.

Effects of Alternative G (Preferred Alternative) on Insects

Salvage

Direct and Indirect Effects

Alternative G would be part of a research project. It involves designating 12 areas, each 30 acres or greater that received high or moderate burn severity. They would have levels of harvest ranging from all trees to none of the trees harvested in those areas. Total area considered would be up to 534 acres for the research project, of which 282 acres would be harvested.

This alternative would remove up to 961 acres (including research units) of fire-killed trees within the fire perimeter. This would reduce the amount of habitat for both bark beetles and wood borers on those acres. Fire-killed trees are only marginal habitat for Douglas- fir, mountain pine, and western pine beetles. Trees severely scorched or killed may be unsuitable for beetle development, as the cambium is often too damaged from heat (Ragenovich 1988, 14-15). “The likelihood of attack by primary bark beetles is low with light needle kill, increases with moderate to heavy defoliation and declines with complete needle mortality and the concomitant fire kill” (Weatherby 2001, 2, 8). Fire-damaged trees would remain on site. These are the preferred hosts for bark beetles. Removal of 961 acres of fire-killed trees would likely have a minor impact on the Douglas-fir beetle population by reducing the number of fire-killed trees on-site. However, this is only marginal habitat for beetle reproduction.

Removal of 961 acres of fire-killed trees would have a greater impact on the flat-headed fir borer populations, as they most often attack and bore into the sapwood and heartwood of trees already been killed by the fire (Ragenovich 1988, 14-15) and these trees would no longer be available as habitat. These populations would increase on those areas not salvaged, approximately 57 percent (1,272 acres) of the high and moderate burn severity areas containing late or mid-seral fire-killed trees, but would be reduced on 961 acres harvested.

Restoration

Direct and Indirect Effects

The effects of restoration on insect populations would be the same as those described under Alternative C.

Cumulative Effects

The removal of 961 acres of fire-killed trees would reduce the habitat on BLM-administered land by 43 percent within the area of the fire-killed mid- and late seral stands. Within the entire Elk Creek Watershed across all land ownerships, this accounts for approximately 1 percent of the 85,424 acres. The removal of 6,000 acres (7 percent of the watershed) of fire-killed and damaged trees on private industrial land would reduce any beetle outbreak on those lands and adjacent areas. This removal would directly reduce the habitat for flatheaded wood borers. They infest dead and weakened Douglas-fir and their attacks will continue for several years, as long as the wood remains sound (Ragenovich 1988, 14-15). This alternative would not remove individual fire-killed trees scattered around the low burn severity areas..

The restoration thinning and subsequent retention of severed trees for coarse woody debris would potentially increase habitat for bark beetles, particularly Douglas-fir beetle. This would occur on stands adjacent to the fire area. Removal of downed trees after thinning would reduce the suitable habitat

for reproduction of Douglas-fir, and Western and Mountain pine beetles. In green trees downed due to wind events, for every two to four downed trees infested, beetles would attack one green standing tree (Hostetler and Ross 1996, 3-4). The potential would be present for this level of beetle activity in downed thinned trees.

Up to 466 acres of stands would be treated for LSR habitat improvement, 134 acres of riparian thinning, and 777 acres of pine thinning in trees over 8" DBH. However they would occur over time and only portions would be treated in a given year. This area is potentially 2 percent of the watershed, but host trees for beetles are scattered within these acres. The downed thinned trees would be marginal habitat as they are generally less than 16" DBH and not the larger sizes the bark beetles prefer. The majority of the live stands within this area would be marginal habitat for beetles as they are not in a weakened condition and are not of large size. A small increase in Douglas-fir beetle populations is possible in thinned stands due to the retention of severed trees for coarse woody debris. It would likely be localized and confined to just areas with thinning operations.

This alternative offers moderate reduction in insect activity in trees within fire-killed areas, slightly less than Alternative E, as the individual fire-killed trees within the low burn severity areas would be retained on-site. The moderate level of thinning restoration would realize the benefits of thinning the suppressed, weakened trees which provide habitat for bark beetles. This may offset the increase in habitat due to retained coarse woody material from the thinning operations. However, the newly-severed downed wood from thinning would provide a more desirable habitat for the Douglas-fir beetle than standing trees. It is likely a slight increase in insect activity would occur due to the retention of severed trees for coarse woody debris due to the restoration thinning.

There are approximately 1,188 acres considered for roadside hazard salvage, which includes a 200' strip of land on both sides of roads within the fire perimeter. Very little salvage would occur below the roads, which constitutes half of the acreage. The actual habitat removal from this salvage would be very scattered over the entire fire area. There is a very slight potential decrease in wood-borer and bark beetle populations due to this action.

3.7 Special Habitats

- Special Habitats include riparian zones, oak woodlands, and meadows.
- 33 percent of BLM-administered land within the Elk Creek Watershed is designated as Riparian Reserve.
- Oak woodlands and meadows have decreased in the last 150 years due to development, agriculture, grazing, invasion of exotic plants, and fire exclusion.
- Oregon white oak woodlands are one of the most at-risk plant communities in Oregon.
- 8 percent of BLM-administered lands within the Elk Creek Watershed are oak woodlands and meadows.

3.7.1 Methodology

Desired future conditions and direction and guidelines for managing riparian vegetation were taken from the NFP Standards and Guidelines (USDA and USDI 1994b, B-12, B-13, C-32), the Medford RMP (USDI 1995, 22, 26-27, 30-31, Appendix E-195), South Cascades LSRA (USDA and USDI 1998b, 96-97, 109, Appendix A 7-8, 19-30), and the Elk Creek WA (USDA and USDI 1996, I-8, II-32, 33, III-17, IV-2-3, 14-15).

Riparian Reserve is a land designation established under the NFP which applies only to Federal lands. The following discussions about Riparian Reserves and buffers apply only to BLM-administered lands.

Riparian acres were calculated based on designated riparian buffer sizes (USDI 1995, 26-27), which are a measurement of site-potential trees for a given site, or the average maximum height of the tallest dominant trees 200 years or older (USDA and USDI 1994b, C-31). Riparian Reserve buffers for the Elk Creek Watershed are two site-potential trees (320 feet) on each side of fish-bearing streams and one site-potential tree (160 feet) on each side of non-fish-bearing perennial, long-term intermittent, and short-term intermittent streams (see Map 3-6). Pre-fire riparian vegetation acres and seral stages came from the WA (USDA and USDI 1996, II-32). Post-fire riparian vegetation acres of burn severity are from satellite imagery. Seral stages are from GIS data. Stream surveys conducted in 2003 provided updated information on the extent and classification of streams in the Watershed. All Riparian Reserve acres were updated to reflect the new data.

Desired future conditions and direction and guidelines for managing oak woodlands were taken from the Medford RMP (USDI 1995, 49), the LSRA (USDA and USDI 1998b, 149-150), and the WA (USDA and USDI 1996, IV-12).

Acres for oak woodlands and meadows differed greatly in the WA (USDA and USDI 1996, II-21) and the LSRA

(USDA and USDI 1998b, 150). These acres were checked against Micro*Storms data which were found to be more accurate and are used for this analysis.

3.7.1.1 Assumptions

Riparian areas burned at high and moderate severity have been set back to an early seral vegetative stage.

3.7.2 Affected Environment

Special habitats are defined as forested or non-forested habitat which contributes to overall biological diversity within the District (USDI 1995, 114). Special habitats in the Elk Creek Watershed include rock outcrops, scablands, wetlands, seeps, moist meadows, riparian zones, oak woodlands, and shrublands.

3.7.2.1 Riparian Vegetation

Riparian zones are transitional between terrestrial and aquatic systems where vegetation and microclimate are strongly influenced by the aquatic system (Gregory, et al. 1991, 540). Riparian areas contribute to the health of the aquatic system by stabilizing stream banks; providing large woody material for complexity and cover for aquatic organisms; and providing shade, flow of nutrients, leaf and litter fall, and sediment delivery (USDA and USDI 1998b, 97).

Riparian Reserves also provide incidental benefits to upland species. These reserves help maintain and restore riparian structures and functions, benefit fish and riparian-dependent non-fish species, enhance habitat conservation for organisms dependent on the transition zone between upslope and riparian areas, improve travel and dispersal corridors for terrestrial animals and plants, and provide greater connectivity of late-successional forest habitat (USDA and USDI 1994b, 7).

A distinction should be made between Riparian Reserves and riparian vegetation. While Riparian Reserves parallel streams and include riparian plants, they also include upland areas considered necessary for maintaining hydrologic, geomorphic, and ecologic processes (USDA and USDI 1994b, B-13). The criteria for determining Riparian Reserve buffer sizes were established in the Northwest Forest Plan for western Washington, Oregon, and northwestern California. Riparian vegetation may be distinct from upland vegetation in species composition and structural attributes. However, many riparian zones in southwestern Oregon that contain true riparian plant species, such as willows, alders, and ninebark, are narrow bands directly along perennial streams, with the remainder of the Riparian Reserve containing vegetation typical of upland plant communities. Intermittent streams often show no distinction in vegetation between the riparian zone and the uplands. The riparian zones in southwestern Oregon differ in composition from other Northwest Forest Plan regions because they are drier and have more frequent fire regimes than the more mesic northern regions.

Healthy riparian zones consist of a mix of overstory conifer and hardwood species and understory shrubs and herbaceous vegetation. If natural ecosystem processes are functioning, frequent disturbances in the form of wind storms, fire, landslides, pathogens, and flooding create a mosaic of early, mid-, and late seral vegetation within riparian zones (Hobbs, et al. 2002, 41).

The Elk Creek Watershed Analysis objectives for riparian vegetation in the watershed include maintaining or restoring habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species (USDA and USDI 1996, IV-14).

Management guidelines include:

- Revegetating with native plant species, including conifers and hardwoods.
- Reducing ladder fuels through thinning from below or by pre-commercial thinning.
- Managing for late-successional forest and closed tree canopy (>70 percent).
- Restoring large conifers.
- Planting native species along barren channels.

Restoring large conifers to provide future large woody debris to the aquatic system is a priority of riparian area restoration. Silviculture treatments that reduce stocking levels and favor diverse species composition in conifer plantations and early seral stands less than 80 years of age along streams would meet this objective in the Elk Creek Watershed.

Pre-fire

The Elk Creek Watershed contains numerous Riparian Reserves along streams classified as fish-bearing and non-fish-bearing perennial, long-term intermittent, and short-term intermittent. Approximately 31 percent of BLM acres (7,495 of 23,866 acres) in the watershed are designated as Riparian Reserves. The majority of acres in the Riparian Reserves contain conifer or mixed hardwood-conifer stands. The remaining acres consist of Oregon oak woodlands, open meadows, shrublands, or rock outcrops.

Typical riparian vegetation in the Elk Creek Watershed consists of a conifer overstory of Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), and incense cedar (*Calocedrus decurrens*), with western hemlock (*Tsuga heterophylla*) and Pacific yew (*Taxus brevifolia*) at higher elevations and moister sites, and ponderosa pine (*Pinus ponderosa*) and sugar pine (*Pinus lambertiana*) at lower elevation, drier sites. Associated hardwoods

include madrone (*Arbutus menziesii*), black oak (*Quercus kelloggii*), bigleaf maple (*Acer macrophyllum*), Oregon ash (*Fraxinus latifolia*), alder (*Alnus rhombifolia*), chinquapin (C*hrysolepis chrysophylla*), and canyon live oak (*Quercus chrysolepis*). Understory shrubs include vine maple (*Acer circinatum*), hazel (*Corylus cornuta* var *californica*), bitter cherry (*Prunus emarginata*), deer brush (*Ceanothus integerrimus*), oceanspray (*Holodiscus discolor*), Oregon grape (*Berberis nervosa* and *B. aquifolium*), and wood rose (*Rosa gymnocarpa*). Ground cover includes a diversity of herbaceous forbs and grasses.

Species composition and structure in Riparian Reserves are similar to that in the uplands, although conditions are moister closer to the stream and trees may be somewhat denser with more ground vegetation. Riparian Reserves along intermittent streams are less distinct from the uplands than those along perennial streams.

The desired future condition within Riparian Reserves on BLM-administered land, as identified in the LSRA (USDA and USDI 1998b, 113), is 75 percent late seral vegetation. Based on the latest GIS data, where late seral vegetation was defined as stands over 80 years of age, 72 percent of riparian vegetation on BLM-administered land within the Elk Creek Watershed was in late seral stage prior to the Timbered Rock Fire. This included stands in the white fir, Douglas-fir, ponderosa pine, and Oregon white oak plant series. Late seral conditions existed in 74 percent of conifer stands (white fir, Douglas-fir, and ponderosa pine). Early seral stands are defined as 0-29 years of age and mid-seral as 30-80 years of age.

The LSRA also states "[T]here may be riparian reserves adjacent to smaller, intermittent streams that cannot maintain this level of late seral vegetation due to fire regimes and site character." (USDA and USDI 1998b, 113). It is likely the seral stages of riparian vegetation in the LSR will fluctuate over time in response to natural processes.

Not all Riparian Reserve conifer stands within the Elk Creek Watershed classified as late seral have late-successional characteristics. These characteristics include multi-species and multi-layered assemblages of trees; moderate-to-high accumulations of large logs and snags; moderate-to-high canopy closure; moderate-to-high numbers of trees with physical imperfections such as cavities, broken tops, and large deformed limbs; and moderate-to-high accumulations of fungi, lichens, and bryophytes (USDA and USDI 1994b, B-5). Most stands require more than 80 years to reach these conditions. However, it is assumed stands designated as late seral riparian stands are on a trajectory to attain late-successional status.

The early and mid-seral stands within the watershed originated as a result of partial or clearcut logging, or fire or other natural disturbances occurring 10-80 years ago. Most early seral stands are plantations planted 10-29 years ago after clearcut or partial cut harvest. Some mid-seral stands are plantations planted 30-80 years ago, but most are naturally regenerating partially cut or burned stands. Although stands are classified by the predominant age class, they may contain occasional residual older and larger trees.

Plantations were originally planted at a density of up to 680 trees per acre (tpa). Because of seedling mortality and vegetation treatments, such as pre-commercial thinning, many currently have an average of about 250 tpa. Other stands currently have up to 900 tpa in all size classes. Most of these trees are smaller diameter conifers that have naturally regenerated from overstory trees and are patchily distributed across the unit.

Follow-up treatments in plantations used silvicultural practices which were traditionally applied to Matrix lands with the objective of maximizing timber production. Planting and thinning was completed with a regular spacing, usually favoring one or two conifer species and resulting in even-aged stands and little species diversity. Trees were planted and replanted at 8 feet by 8 feet spacing to maximize tree growth and increase volume of the whole stand versus increasing growth and volume of individual trees.

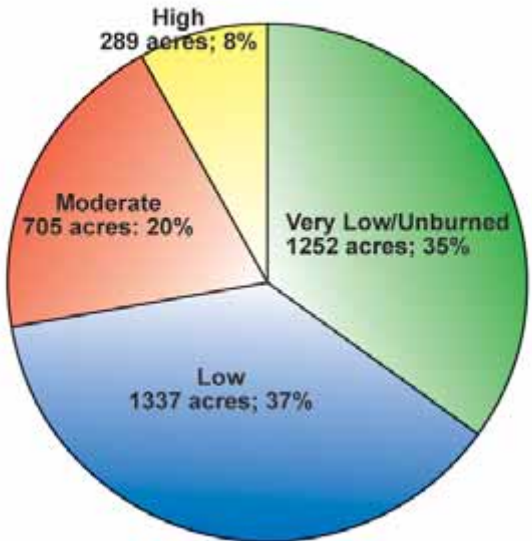
Post-fire

Inside the Fire Perimeter

Riparian Reserves occur on 30 percent (3,583 acres) of BLM-administered land within the Timbered Rock Fire perimeter. Thirty-five percent of the Riparian Reserves were unburned (see Figure 3.7-1).

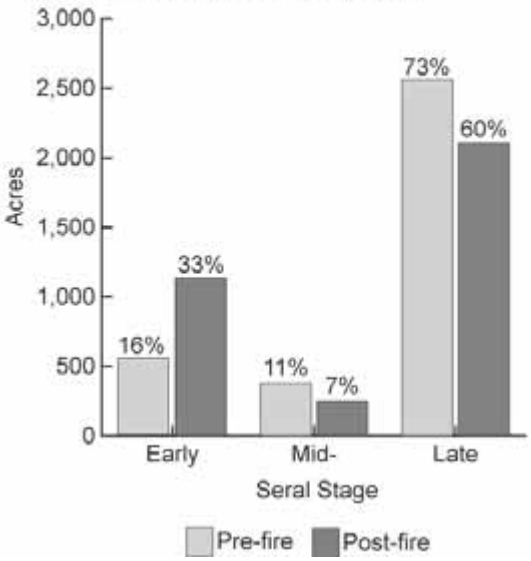
Late and mid-seral stage conifer stands (white fir, Douglas-

Figure 3.7-1. Burn Severity in Riparian Reserves within the Timbered Rock Fire (BLM)



fir, and ponderosa pine plant series) on BLM-administered land burned at high and moderate severity were returned to an early seral condition after the Timbered Rock Fire (see Figure 3.7-2). Riparian Reserve conifer stands on BLM-administered land in late seral condition dropped from 73 percent to 60 percent within the fire perimeter. These figures are based on the latest GIS data where late seral stages are defined as 80 years or older.

Figure 3.7-2. Pre- and Post-fire Seral Stages of Conifer Stands in Riparian Reserves within the Fire Perimeter (BLM)



No data is available for seral stages in riparian areas on private land. However, for this analysis, it is assumed much of the riparian vegetation on private land is in early seral condition. Those riparian areas in an early seral condition do not provide the benefits of late-successional vegetation to the aquatic system, such as shade and large wood.

Vegetation along Flat and Middle creeks was the most impacted from the fire because the areas burned at high severity. A high percentage of these two drainages are on private land which has been extensively logged, both before and after the fire.

The effects of fire on riparian vegetation, and its ability to recover after fire, depend on the intensity of the fire. In high burn severity areas, much of the vegetation and duff was consumed and the majority of trees killed. In areas less severely burned, understory shrubs and herbaceous vegetation, small trees, and some large trees were killed. In areas burned at lower severity, less plant mortality occurred. Some riparian areas burned at lower fire severity than surrounding areas because of moister microsite conditions.

Post-fire recovery of riparian vegetation depends on survival of overstory trees and burn severity of duff and soil. Large ponderosa pine and Douglas-fir are more resistant to fire than hardwoods and other conifers because of their thick bark, but they do not have the ability to resprout after fire, as most hardwoods do. Big leaf maple, madrone, black oak, vine maple, hazel, bitter cherry, canyon live oak, chinquapin, deer brush, oceanspray, Oregon grape, wood rose, and bear grass are tree and shrub species observed resprouting in the Timbered Rock Fire area even before the fire was controlled (Wineteer 2002; Wineteer 2003). These species and others have adaptations that allow them to resprout from the trunk, branches, root crown, stump, or below ground plant parts and regenerate quickly after fire. Even in high burn severity riparian areas these resprouting hardwoods and shrubs provide some shade and protection from erosion.

Other species have adaptations that allow them to recover quickly after fire, including windborn or water-dispersed seeds, fire-enhanced flowering and fruit production, seeds with resistant coats, or seeds retained in closed cones that require fire for germination.

Initial natural regeneration of conifers in the first year after the fire at Timbered Rock was high, although survival of these seedlings may be limited by competition from brush and resprouted hardwoods. Under the Timbered Rock Fire Emergency Stabilization/Rehabilitation Plan (ESRP), the priority for conifer seedling planting was old plantations and high burn severity areas on BLM-administered land, including riparian zones. The one to two foot seedlings will have a better chance of competing with other vegetation and allow accelerated development of a conifer component in those areas. Private commercial timber companies also replanted their land with conifers after salvage was complete.

Some Riparian Reserves within the fire did not burn or burned at very low severity are already in a late seral stage, while others are in early or mid-seral stages. Conditions in early and mid-seral stands would be similar to those described outside the fire perimeter.

Outside the Fire Perimeter

Riparian Reserves on BLM-administered land located outside the fire perimeter but within the LSR total 3,912 acres. Fifteen percent of the conifer stands are in an early seral stage, 9 percent in mid-seral stage, and 76 percent in late seral stage (see Table 3.7-1).

Table 3.7-1. Seral Stages of Riparian Reserve Conifer Stands Outside the Fire but within the Watershed (BLM)

Seral Stage	Acres	Percent
Early	549	15%
Mid-	327	9%
Late	2,801	76%
Total	3,677	100%

Some early and mid-seral plantations are currently in an over-stocked condition and lack structural complexity and species diversity in both overstory trees and understory shrubs and herbaceous vegetation (see Figure 3.7-3). They lack large snags and coarse woody debris. Trees growing close together compete with each other for light, water, and nutrients, resulting in slowed growth of all trees. Lower branches are lost in a self-thinning response to competition. These trees do not develop the wide, deep crowns with spreading branches that are an important feature of old-growth forests and provide substrate for lichens and bryophytes and habitat for wildlife.

Figure 3.7-3. Overstocked mid-seral riparian stand along West Branch Elk Creek

Conifers in early seral plantations are often over-topped (surpassed) or out-competed by shrubs and hardwoods that grow fast and dense in the first couple of years after disturbance and tree canopy removal. Canopy cover of conifers may be less than 40 percent in these stands, although the understory of shrubs and hardwoods may be much higher.

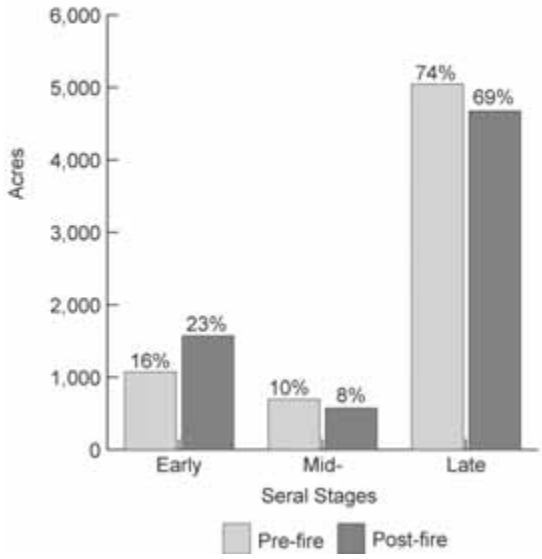
Some mid-seral stands contain dense conifers that compete with each other for light and moisture, resulting in reduced tree growth and small narrow crowns with few lower branches. Some stands over 20 or 30 years of age are over-stocked, have large amounts of decadent shrubs or dead and down conifers, and contain high fuel loads at risk of high tree mortality in the event of wildfire.

Although stands under 80 years of age would eventually develop late-successional characteristics on their own, it would take longer and could involve set-backs from wind or ice storms, root-rot, insect infestations, or fire. Studies have shown that thinning in plantations less than 80 years old resulted in faster tree growth and increases in biological diversity in just a few years, with accelerated development of old-growth characteristics projected within one to two decades (Rapp 2002, 3, 6).

Watershed Level Conditions

Riparian Reserve late seral vegetation in white fir, Douglas-fir, ponderosa pine, and oak woodland plant series on BLM-administered land within the Elk Creek Watershed dropped from 74 percent to 69 percent after the fire (see Figure 3.7-4).

Figure 3.7-4. Pre- and Post-fire Seral Stages of Conifer Stands in Riparian Reserves within Elk Creek Watershed (BLM)



LSRs are intended to provide large, contiguous areas of late-successional habitat for wildlife and other old-growth associated species. Riparian Reserves provide connectivity between forest habitat and migration corridors for plants and animals. As a result of the Timbered Rock Fire, 5 percent less late seral Riparian Reserve habitat is available to provide late-successional functions in the Elk Creek Watershed on BLM-administered land. Combined with the checkerboard ownership pattern in the LSR and early seral conditions on private land, even less habitat provides late-successional functions at the watershed level.

Post-fire Priority Treatments in Elk Creek Watershed Riparian Reserves

- Plant high burn severity areas.
- Plant areas impacted during fire suppression activities.
- Thin in early and mid-seral stands along perennial fish-bearing streams.
- Thin in early and mid-seral stands along perennial (non-fish-bearing) and long-term intermittent streams.
- Thin in early and mid-seral stands along short-term intermittent stream.

High burn severity areas and areas that were impacted during fire suppression activities are the highest priority Riparian Reserves in the Elk Creek Watershed for treatment. Planting of these areas was proposed and analyzed under the

Timbered Rock Fire ESRP and implementation began in fall 2002 and spring 2003 and will continue into the near future.

Improving unburned early and mid-seral stands and accelerating development of late-successional characteristics within the fire perimeter is also a high priority because of the loss of late seral riparian vegetation on all land ownerships. Fish-bearing perennial streams are a high priority to treat because the products of the treatment, such as shade and coarse woody debris, would provide direct benefits to fish and hydrological resources. Treatment of non-fish-bearing long-term intermittent streams would indirectly benefit aquatic as well as terrestrial resources.

3.7.2.2 Oak Woodlands and Meadows

Oak woodlands and meadows provide diversity across the landscape and support unique plants and wildlife. They are discussed together in this document because of their proximity to and continuity with one another in the Elk Creek Watershed.

Oregon white oak woodlands are a prominent ecosystem in the interior valleys and foothills of Oregon and Washington between the Coast Range and Cascade Mountains. They are characterized by low rainfall, shallow soils, and a historic frequent, but low intensity, fire regime. Prior to Euro-American settlement of the Rogue Valley, oak woodlands and meadows were likely maintained in an open condition by the Native American practice of burning (Franklin and Dyrness 1988, 110-115; Thilenius 1968, 1124-1125; Riegel, et al. 1992, 66-68).

Oregon oak woodland and meadow ecosystems have decreased in the last 150 years due to development, agriculture, grazing, invasion of exotic plants, and fire exclusion. Oregon white oak woodlands are one of the most at-risk plant communities in Oregon. They are ranked G1S1 and G2S2 by the Oregon Natural Heritage Program, which means they are considered globally and state critically imperiled because of very few remaining acres (Kagan, et al. 2001, 39).

Pre-fire

Oregon oak woodlands and meadows comprise only 8 percent of BLM-administered land in the Elk Creek Watershed, but are more extensive on USACE land in the lower Elk Creek drainage. Oregon oak woodlands and meadows occur mostly in the southern part of the watershed in drier sites on south-facing slopes at elevations below 1,900 feet.

Riegel (1992, 68) defines Oregon oak woodlands in southwestern Oregon as areas with greater than 20 percent tree cover, whereas Agee (1933, 351) describes them as areas having greater than 30 percent tree cover and 60-120 tpa. These plant communities are fire-dependent with an estimated historic fire return interval in the range of 5-15 years (USDA and USDI 1998, 81). They are likely maintained by fire (see Figure 3.7-5). Many herbaceous plants associated with oak woodlands and meadows are short-lived and depend on fire for seed germination or regeneration. Fire exclusion during the last 150 years has resulted in alterations in species composition, structure, and ecosystem processes.

Figure 3.7-5. Low severity burn in an oak woodland and meadow (Summer 2003)

Typical plant composition in oak woodlands consists of an overstory of Oregon white oak (*Quercus garryana*) with occasional ponderosa pine (*Pinus ponderosa*). The understory consists of a well-developed herbaceous layer of forbs and grasses with a minor shrub layer. Poison oak (*Toxicodendron diversiloba*) is a frequent understory shrub. Idaho fescue (*Festuca idahoensis*) and other native bunchgrasses grow under the dripline of oak trees. Other bunchgrasses, like California oatgrass (*Danthonia californica*) and Lemmon's needlegrass (*Achnatherum lemmonii*), occur in more open areas.

Fire exclusion in Oregon oak woodlands has resulted in increased oak and shrub cover and invasion of competing conifers, including Douglas-fir (*Psuedotsuga menziesii*) and incense cedar (*Calocedrus decurrens*). This increase in canopy cover and vegetation density resulted in decreased understory species diversity and abundance, increased fuel loads, and reduced seed germination and tree and shrub regeneration.

In the event of wildfire, heavy fuel loads could lead to high intensity and long duration fire resulting in total plant mortality or damage to above- and below-ground plant parts. In the absence of fire, shrubs become large, decadent, and unpalatable forage for wildlife (see Figure 3.7-6). The oak woodlands are at risk of converting to more closed canopy hardwood-conifer woodland, a plant community widespread

Figure 3.7-6. Decadent ceanothus and manzanita shrubs at edge of oak woodland

across the foothills of the Rogue Valley. With this change in habitat and habitat conditions, plant species dependent on a more open canopy will be shaded out.

Meadows in the Elk Creek Watershed can be characterized as two different types. One type occurs as openings within oak woodlands or chaparral where shallow soils do not support tree or shrub species. They are best described as dry, rocky balds or scablands. They are often interspersed with rock outcrops and occasionally small seeps. Vegetation consists mostly of annual grasses and forbs. Most of these meadows occur on soils in the McMullin series, which have a high clay content and cobbly surface. These soils are subject to frequent shrink-swell disturbance, which leaves them susceptible to invasion by nonnative annual grasses and noxious weeds.

A second meadow type occurs on deeper soils and contains a mix of annual and perennial grasses and forbs with scattered individuals or patches of wedgeleaf ceanothus (*Ceanothus cuneatus*) and manzanita (*Arctostaphylos viscida*) shrubs. Many of the native grasses associated with these meadows are bunchgrasses, which grow in a scattered pattern with spaces in between. In a healthy ecosystem, a variety of delicate, annual forbs bloom between them in the spring and summer. Some areas in these meadows have converted to annual grasslands, with more non-native annual grasses and fewer native perennial bunchgrasses.

Fire exclusion has resulted in encroachment by Douglas-fir (*Pseudotsuga menziesii*) and incense cedar (*Calocedrus decurrens*) around the edges of the meadows and an increase in nonnative species. Species dependent on frequent, low-intensity fire for regeneration, seed germination, or removal of dead layers of vegetation are at risk of disappearing from these meadows.

Livestock grazing in the past may also have damaged the meadows and contributed to the conversion from native perennial bunchgrasses to annual grasses. Cattle preferentially browse native bunchgrasses over nonnative annual grasses, resulting in decline of the preferred species and increase in the less desirable and unpalatable nonnatives.

Two nonnative plants in the Timbered Rock analysis area may become dominant species in oak woodlands and meadows: Medusahead (*Taeniatherum caput-medusae*) and yellow starthistle (*Centaurea solstitialis*). After initial invasion, both species are successful at creating conditions that favor their perpetuation.

Medusahead (*Taeniatherum caput-medusae*), an annual grass, has become widespread and problematic throughout open plant communities in southwestern Oregon due to fire exclusion and past disturbances, particularly overgrazing by livestock. It is successful at competing with native perennial grasses after disturbance, but is less successful at invading areas with established native perennial bunchgrasses. Medusahead matures early in the summer, drops abundant seeds, and creates a thick thatch of fine, dry material by late summer. This thatch suppresses native grass seedlings and forbs and burns at a higher intensity than native species. Not only can existing native grasses and forbs be damaged under this fire regime, but the nonnative annual species are able to quickly invade again into the disturbed area because of their reproductive strategies.

Yellow starthistle (*Centaurea solstitialis*) is a noxious weed present in the Elk Creek Watershed. It is found mostly at lower elevations along the main branch of Elk Creek on private land and USACE land. Like Medusahead, it invades quickly into disturbed habitats. However, it is more successful at competing with native bunchgrasses, in part because it puts down a deep taproot in the fall and is able to secure water throughout the dry summer months.

There are a number of possible controls for yellow starthistle and medusahead. Maintenance of a healthy native perennial grass stand is the most effective deterrent to invasion by nonnative grasses and forbs. Treatment of small populations before they expand is also important. Oak woodlands and meadows in the Elk Creek Watershed are located mostly on steep, rocky slopes, limiting the treatment methods that may be used.

Prescribed fire, applied at low intensity, followed by seeding native perennial grasses, may be successfully used to reduce the extent of annual grasses and increase natives. Fire has the added benefit, if applied during the right time of year, of rejuvenating native bunchgrasses and improving their chances of out-competing nonnative annual grasses. There are some risks involved with using fire where nonnative grasses dominate. If the fire is too intense, it may damage existing perennial grasses and open areas to invasion by

more nonnatives. Timing and intensity of prescribed burns must be determined for each area in relation to habitat conditions, including the proportion of native versus nonnative species present.

Another method for reducing nonnative and increasing native grasses in woodlands or shrublands dominated by nonnative annual grasses is to burn piles of brush or small trees that are thinned. A high intensity fire would kill all the seeds under the burn piles and leave a medium in which native grass seed, when applied, would germinate and grow quickly. These burned and seeded patches would create islands of native grasses that could serve as a seed source for surrounding areas (Hosten 2003).

In areas with a high proportion of nonnative species, more than one approach is probably needed to reduce the extent of nonnative species and increase natives. Prescribed fire, used in conjunction with weed treatment prior to burning, seeding with native grass seed after burning, or mulching seed would provide a greater likelihood of success.

Post-fire

Approximately 692 acres of Oregon white oak woodland and meadows are located within the Timbered Rock Fire perimeter on BLM-administered land. About 1,222 acres are located on BLM-administered land outside the fire perimeter but within the Elk Creek Watershed. Within the fire perimeter, roughly 8 percent of the oak woodlands and meadows burned at high severity, 51 percent at moderate severity, 33 percent at low severity, and 7 percent at very low severity or unburned.

Preliminary observations of some oak woodlands and meadows after the fire suggest the fire accomplished the structural management objectives for these plant communities by killing some encroaching conifers, small diameter oaks, and shrubs (Wineteer 2003)(see Figure 3.7-7). Large oaks and ponderosa pine appeared to have sustained less damage.

The fire burned in a patchy pattern with different burn severities across these habitats. Some stands were untouched, while others burned at high severity. The results are a mosaic of age classes and conditions.

No botanical surveys were conducted in the Elk Creek Watershed prior to the fire to assess the condition of oak woodlands and meadows and determine the extent of nonnative plant species within them. For this reason, comparisons cannot be made between pre- and post-fire conditions. Future treatments would use existing conditions as the baseline.

Oak woodlands and meadows outside the fire perimeter, but within the Elk Creek Watershed, are in the same condition as those described under pre-fire conditions. These areas need treatment to maintain or restore their historic structure, improve conditions, preserve a diversity of native plant species, and reduce hazardous fuel levels.

3.7.3 Environmental Consequences

3.7.3.1 Riparian Vegetation

General guidelines for managing riparian plant communities include maintaining or restoring species composition and structural diversity to promote late-successional characteristics. Silviculture treatments may be used in Riparian Reserves in LSRs to achieve Aquatic Conservation Strategies if they are neutral or beneficial to the creation and maintenance of late-successional habitat (USDI 1995, 33).

Effects Common to All Alternatives

Salvage

Direct and Indirect Effects

No salvage activities are proposed in Riparian Reserves, except on 11 acres in three research units under Alternative G. No road building would occur in Riparian Reserves under any alternative. Under all alternatives some hazard trees in Riparian Reserves within 200 feet of roads may be cut to prevent them from falling into the road. They would be left on-site. Except for those effects described under Alternative G, salvage activities would not have negative direct or indirect effects to riparian vegetation because salvage operations would occur outside riparian buffers.

Restoration

Direct and Indirect Effects

Proposed restoration projects that involve riparian vegetation are thinning and planting within Riparian Reserves (see Map 3-6). Only early and mid-seral stands in Riparian Reserves are proposed for thinning. Within the fire perimeter only unburned and very low burned early and mid-seral stands in the Riparian Reserves would be thinned. The riparian areas treated would be 320 feet on either side of fish-bearing perennial streams and 160 feet on either side of non-fish-bearing perennial and intermittent streams. All streams would have a 30-foot no-cut buffer on either side of the stream, except coho streams which would have a 50-foot no-cut buffer on either side of the stream.

Direct effects to riparian vegetation would be removal of some trees and shrubs. However, the treatment would indirectly benefit the stands because it would increase growth of leave trees, promote development of late seral characteristics in the stand, and increase diversity of understory species. Slash resulting from thinning treatments would be piled and burned to prevent excessive fuel loads of

Figure 3.7-7. Low severity burn killed some ceanothus while oaks and pines along ridge survived (summer 2003)

small diameter material on the forest floor.

Under all alternatives, conifers would be planted in riparian areas within the fire. Initial plantings would be with regular spacing, but some variability would be achieved by emphasizing microsite planting (e.g. next to cut stumps). Future thinning treatments would provide additional variability in spacing, structure, and species diversity. Most hardwoods recovered after the fire by resprouting from existing burls or trunks, but under the Timbered Rock Fire ESRP some riparian hardwood trees and shrubs were planted along streams lacking a hardwood component.

No negative direct or indirect effects are expected from the reforestation efforts. Beneficial effects to vegetation would be realized, however, by speeding up development of a conifer component. Most hardwoods and shrubs resprouted immediately after the fire and grew one to several feet during the first year. Naturally regenerating conifers are only a couple of inches tall. One to two foot seedlings that would be planted would have a better chance of competing with hardwood trees and shrubs and would achieve dominance in the stand sooner. Planting conifers and hardwoods would benefit the riparian areas by accelerating the recovery process, eventually providing shade and future large woody debris to streams, and stabilizing soil to prevent erosion.

Some culvert replacement projects and placement of fish structures in streams would occur in Riparian Reserves, but any effects to vegetation would be temporary. Culvert replacement projects would ultimately improve conditions in the stands by reducing erosion. Placement of fish structures in streams would benefit aquatic resources and would have a neutral effect on riparian vegetation. Other restoration projects would have no effects on riparian vegetation because they would occur outside the riparian buffers.

Cumulative Effects

During the Timbered Rock Fire, approximately 5 percent of riparian vegetation across all land ownerships burned at high severity and 14 percent burned at moderate severity. 289 acres of Riparian Reserves on BLM-administered land burned at high severity and 705 acres burned at moderate severity, resulting in 13 percent less late seral conifer stands at the watershed level. These early seral Riparian Reserves no longer provide the benefits of late-successional vegetation to the riparian system.

Some riparian areas adjacent to roads were impacted during fire suppression activities. Trees and shrubs between those roads and streams were cut in the process of opening the road for access by fire suppression equipment. Stream bank vegetation was disturbed in several places where streams were crossed. In one location the roadside streambed was altered. These areas were rehabilitated after the fire during post-fire suppression rehabilitation or under the Timbered Rock Fire ESRP.

Past timber harvesting and road building on both private and public land in the Elk Creek Watershed have removed or altered Riparian Reserve vegetation.

Prior to the NFP and establishment of Riparian Reserve buffers, some riparian areas on BLM-administered lands in the Elk Creek Watershed that now fall in Riparian Reserves were clearcut or partially cut. These areas were replanted with one or two conifer species in a regular spacing with 680 trees per acre. Many of the 10-80 year old stands in Riparian Reserves are currently overstocked, lack species diversity, have large amounts of shrubs or small diameter dead and down conifers, and contain high fuel loads, putting them at risk of high tree mortality in the event of another wildfire.

The cumulative effect of past activities on riparian vegetation on both private and federal lands in the Elk Creek Watershed is a reduction in late seral vegetation and an increase in young dense stands with little variability in structure or species diversity and high levels of hazardous fuels.

Effects of Alternative A (No Action) and Alternative F on Riparian Vegetation

- These alternatives would have a neutral effect on riparian vegetation, with the exception of a slight negative effect on early and mid-seral riparian conifer stands because no thinning projects to improve late-successional characteristics would occur.
- No proposed actions in these alternatives would prevent attainment of Aquatic Conservation Strategy objectives for Riparian Reserve vegetation.

Salvage

Direct and Indirect Effects

Under Alternatives A and F, no salvage and no impacts to riparian vegetation from salvage operations would occur.

Restoration

Direct and Indirect Effects

Under Alternatives A and F, no riparian thinning or planting restoration projects are proposed.

Not thinning early and mid-seral Riparian Reserves would result in no direct effects to riparian vegetation. However, there would also be no indirect benefits of reducing some competing conifers and shrubs that could accelerate development of late-successional characteristics in the stands. In the event of wildfire, dense stand conditions in some of the riparian areas could result in higher severity fire and greater tree mortality than would occur if stands were thinned.

Cumulative Effects

Cumulative effects under Alternatives A and F would include Cumulative Effects Common to All Alternatives. Under Alternatives A and F there would be no change in current conditions or trends in riparian vegetation in the Elk Creek Watershed. These alternatives would add no additional negative cumulative effects, but there would be no beneficial effects in early and mid-seral stands from restoration projects.

Effects of Alternative B on Riparian Vegetation

- Proposed thinning and planting in 10-29 year old conifer stands in Riparian Reserves along perennial streams would provide beneficial effects to riparian vegetation and riparian systems in those stands.
- Conditions in 30-80 year old conifer stands along perennial and intermittent streams and 10-29 year old stands along intermittent streams would not be improved because those areas would not be treated.
- No proposed actions in this alternative would prevent attainment of Aquatic Conservation Strategy objectives for Riparian Reserve vegetation.

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage and no impacts to riparian vegetation from salvage operations would occur.

Restoration

Direct and Indirect Effects

Under Alternative B, 117 acres of 10-29 year old conifer stands along perennial streams, with canopy cover greater than 40 percent, would be manually thinned. Conifers would be thinned to leave 110-220 trees per acre. Up to 25 conifers would be selected and all vegetation within a 5-foot radius of the dripline would be cut to release these trees from competition and accelerate growth. In units with less than 110 trees per acre, shrubs would be cut around the selected conifers.

Preferred leave trees would be conifers greater than eight inches diameter and a mix of conifer and hardwood species. Cut material would be piled and burned to prevent accumulation of excessive amounts of fine fuels on the forest floor. The objective of the treatment would be to release conifers from competition with each other and surrounding shrubs, and to accelerate growth rates for leave and select trees.

Direct effects would be removal of some riparian shrubs and conifers less than eight inches in diameter. This treatment would indirectly affect vegetation by opening up the canopy slightly around the select trees and causing somewhat drier conditions in the short-term. However, over the long-term, thinning around the select trees would contribute to the health of the stand by allowing some trees to develop without competition, by promoting age variability and structural complexity within the stand, and by reducing hazardous fuel levels.

Cumulative Effects

Cumulative effects under Alternative B would include Cumulative Effects Common to All Alternatives. No additional negative effects to riparian vegetation would be contributed by the activities proposed under this alternative. Thinning early seral riparian stands along perennial streams would provide beneficial effects to riparian vegetation and the aquatic system in those stands. Conditions in mid-seral stands and early seral stands along intermittent streams would not improve under this alternative because no treatments in those areas would occur.

Effects of Alternative C on Riparian Vegetation

- Proposed thinning and planting in early and mid-seral conifer stands in Riparian Reserves along perennial streams would have beneficial effects to riparian vegetation and riparian systems by promoting development of late-successional characteristics in those stands.
- This alternative would not provide beneficial effects to early and mid-seral conifer stands along intermittent streams because those areas would not be thinned.
- No proposed actions in this alternative would prevent attainment of Aquatic Conservation Strategy objectives for Riparian Reserve vegetation.

Salvage

Direct and Indirect Effects

Under Alternative C, no salvage would occur in Riparian Reserves. There would be no impacts to riparian vegetation as a result of salvage operations.

Restoration

Direct and Indirect Effects

Under Alternative C, 225 acres of early seral riparian conifer stands (10-29 years old) with canopy cover greater than 40 percent would be manually thinned. In early seral stands with less than 40 percent canopy cover and a dense shrub layers, shrubs would be cleared around selected trees.

Conifers would be thinned to leave 110-220 trees per acre. Up to 25 conifers would be selected and all vegetation within a 5-foot radius of the dripline would be cleared in order to release these trees from competition and accelerate growth. In units with less than 110 trees per acre, shrubs would be cut around the selected conifers.

Preferred leave trees would be conifers greater than 8" DBH and a mix of conifer and hardwood species. Cut material would be piled and burned to prevent accumulation of excessive amounts of fine fuels on the forest floor. The objective of the treatment would be to release conifers from competition with each other and surrounding shrubs and accelerate growth rates for leave and select trees.

Thinning would occur on134 acres of mid-seral stands (30-80 year old) with greater than 60 percent canopy cover. Twelve conifers per acre would be selected to clear around. Only trees with the crowns touching the selected trees would be cut. Small gaps irregularly spread across the stand would be created from the thinning. Vegetation between the gaps would be left intact. Preferred leave trees would be conifers greater than 8" DBH and a mix of conifer and hardwood species. The objective of the treatment would be to create spatial and species diversity and accelerate the growth rates of select trees in order to promote age variability and late-successional characteristics along perennial streams.

Based on LSR Assessment guidelines, 5 percent of existing coarse woody debris would be left in mid-seral stands. Small cut material would be piled and burned to reduce the risk of high intensity fire in the event of wildfire. Larger trees would be left on-site, with some trees lined into streams for fish habitat restoration. Where downed wood exceeds 20 tons per acre, trees to be cut would be girdled instead, which would provide coarse woody debris in 7-10 years. Leaving more than 20 tons of material on the ground would create a fuel load that could contribute to higher burn severity in the event of wildfire in the future.

Direct effects would be removal of some riparian shrubs and conifers less than eight inches in diameter. Canopy cover around the selected leave trees would be slightly opened up resulting in somewhat drier conditions in the short-term. However, over the long-term, thinning around the select trees would contribute to the health of the stand by allowing some trees to develop without competition, by promoting age variability and structural complexity within the stand, and by reducing hazardous fuel levels.

In dense, mid-seral stands, understory vegetation is often lacking. Opening up the canopy would contribute to species diversity of understory shrubs and herbaceous vegetation. These shrubs and herbs protect the soil from erosion and create and maintain moisture better than duff alone. Thinning in stands where trees are stressed from lack of moisture and light would reduce the risk of high tree mortality in the event of wildfire.

Cumulative Effects

Cumulative effects under Alternative C would include Cumulative Effects Common to All Alternatives. No additional negative effects would be contributed by the activities proposed under this alternative. Thinning in early and mid-seral riparian stands along perennial streams would provide beneficial effects to riparian vegetation and the aquatic system in those stands. Conditions in early seral and mid-seral stands along intermittent streams would not improve under this alternative because no treatments in those areas would occur.

Effects of Alternative D on Riparian Vegetation

- Thinning and planting projects proposed under Alternative D in early and mid-seral conifer stands in Riparian Reserves along perennial streams would benefit riparian vegetation and riparian systems by promoting development of late-successional characteristics.
- There would be no beneficial effects to early or mid-seral riparian conifer stands in Riparian Reserves along intermittent streams because they would not be treated.
- No proposed actions in this alternative would prevent attainment of Aquatic Conservation Strategy objectives for Riparian Reserve vegetation.

Salvage

Direct and Indirect Effects

Under Alternative D, no salvage would occur in Riparian Reserves. There would be no impacts to riparian vegetation as a result of salvage operations.

Restoration

Direct and Indirect Effects

Proposed thinning under Alternative D would be the same as that in Alternative C, except that 4.8 percent ground cover of coarse woody debris, based on the DecAID model (versus LSR Assessment guidelines used in Alternative C), would be left. Effects to riparian vegetation would be the same as those described under Alternative C.

Cumulative Effects

Cumulative effects under Alternative D would include Cumulative Effects Common to All Alternatives. No additional negative effects would be contributed by the activities proposed under this alternative. Thinning in early and mid-seral conifer stands along perennial streams would provide beneficial cumulative effects to riparian vegetation and the aquatic system, but no benefits would be provided to early and mid-seral stands along intermittent streams.

Effects of Alternative E on Riparian Vegetation

- Alternative E would provide beneficial effects from thinning in early and mid-seral riparian vegetation in Riparian Reserves along both perennial and intermittent streams because treatment would occur in all these stands.
- No proposed actions in this alternative would prevent attainment of Aquatic Conservation Strategy objectives for Riparian Reserve vegetation.

Salvage

Direct and Indirect Effects

Under Alternative E, no salvage would occur in Riparian Reserves. There would be no impacts to riparian vegetation as a result of salvage operations.

Restoration

Direct and Indirect Effects

Under Alternative E, thinning in 10-29 year old conifer stands in Riparian Reserves would be similar to that proposed in Alternatives C and D, except 437 acres would be treated along both perennial and intermittent streams, instead of 225 acres along just perennial streams. In 30-80 year old conifer stands, 613 acres along perennial and intermittent streams would be thinned, instead of 134 acres along just perennial stands. Under Alternative E, up to 160 square feet of tree basal area per acre would be left. At least 60 percent canopy cover would be retained. Spacing between trees would be variable and different sizes of trees would be left. There would be more selected trees spread out across the stand versus small gaps that would result under Alternatives B, C, D, and G.

Direct and indirect effects to riparian vegetation would be the same as those described under Alternative C.

Cumulative Effects

Cumulative effects under Alternative E would include Cumulative Effects Common to All Alternatives. No additional negative effects would be contributed by the activities proposed under this alternative. Thinning in early and mid-seral conifer stands along perennial and intermittent streams would provide beneficial cumulative effects to riparian vegetation and the aquatic system in those stands.

Effects of Alternative G (Preferred Alternative) on Riparian Vegetation

- Under Alternative G, fire-killed trees would be harvested on 11 acres within Riparian Reserves along intermittent streams, but the effect of salvage logging on riparian vegetation would be neutral at the watershed scale.
- Thinning and planting proposed in early and mid-seral conifer stands in Riparian Reserves along perennial streams would have beneficial effects to riparian vegetation and riparian systems in those stands.
- Under this alternative no beneficial effects would be provided to riparian conifer stands in Riparian Reserves along intermittent streams because no treatment would occur in those stands.
- No proposed actions in this alternative would prevent attainment of Aquatic Conservation Strategy objectives for Riparian Reserve vegetation.

Salvage

Direct and Indirect Effects

Under Alternative G, salvage harvest would occur on 11 acres in Riparian Reserves in order to achieve the research objectives of having consistent stand conditions throughout study areas. The 11 acres, which are spread across 3 different drainages, are adjacent to intermittent streams in 3 research units that burned at high or moderate severity. Remaining snags would equal 6 snags greater than 20" DBH per acre. No ground-based equipment would be used on the 11 acres during salvage operations; salvaged trees would be removed by cable in 2 units and by helicopter in 1 unit.

Direct effects of salvage operations on riparian vegetation would be removal of some fire-killed trees on 11 acres. The only anticipated indirect effect would be an unquantifiable loss of soil productivity in those areas where dead trees are removed. This effect is not well-understood, but could create a slight adverse effect to recovering riparian vegetation from removing future coarse woody debris that contributes to nutrient recycling. However, under natural historic conditions, snags and coarse woody material would not have been evenly distributed across the landscape. Removing all but 6 snags per acre on 11 acres is not likely outside the range of natural variability for riparian areas on BLM-administered land in the Elk Creek Watershed. All other snags in Riparian Reserves within the Timbered Rock Fire area would be left, including hazard trees that are cut along roads. CWD amounts are more than adequately provided in those stands, both within the three drainages where the 11 acres occur and across the watershed.

The scale of disturbance on the 11 acres is very small. Although there may be a slight negative effect to 11 acres as a result of harvesting some snags, only .3 percent of riparian vegetation within the fire perimeter and less than .2 percent within the watershed would be affected. It would not prevent attainment of the Aquatic Conservation Strategy objectives for riparian vegetation at the watershed scale.

The benefit received from the proposed research outweighs the risk of an unquantifiable loss of soil productivity and slowed tree growth on those 11 acres. This set-back, if any, would be off-set by planting conifers in these units and thinning in the future to accelerate growth of select conifer trees. The information gained from the research about the effects of salvage on wildlife could be used in future management decisions.

No other direct or indirect effects to riparian vegetation would occur from salvage operations.

Restoration

Direct and Indirect Effects

Direct and indirect effects from thinning and planting proposed in Riparian Reserves would be the same in Alternative G as those described under Alternative C.

Cumulative Effects

Cumulative effects under Alternative G would include Cumulative Effects Common to All Alternatives. The thinning in early and mid-seral conifer stands along perennial streams that would occur under this alternative would provide beneficial cumulative effects to riparian vegetation and the aquatic system in those stands. Any potential negative effects that might occur from salvage logging trees on 11 acres in Riparian Reserves would be minimal and would not contribute additional cumulative effects at the watershed level.

3.7.3.2 Oak Woodlands and Meadows

Because of their diminishing extent, oak woodlands are considered in the Medford District RMP as a special habitat needing management attention. Direction is given to manage them to maintain or enhance values for wildlife habitat, range, botanical values, and biological diversity (USDI 1995, 49).

Although the primary management objective in the Elk Creek LSR is to promote late-successional habitat for old-growth associated species, specific management actions are also recommended for Oregon white oak plant communities and meadows in the Elk Creek WA (USDA and USDI 1996, IV-12) and the South Cascades LSRA (USDA and USDI 1998b, 149-150). Manually thinning small-diameter white oaks; removing competing conifers; clearing around large, healthy pine; manually cutting, piling, and burning older brush patches; and applying frequent low intensity prescribed fire are activities that could be implemented to maintain oak woodlands and meadows in the absence of fire.

Effects Common to All Alternatives

Salvage

Direct and Indirect Effects

No effects to oak woodlands or meadows are expected from salvage operations. Salvage would not occur and no temporary road construction is proposed in these habitats.

Restoration

Direct and Indirect Effects

The only restoration activities expected to affect oak woodlands or meadows are those activities proposed for their restoration. Only the effects of treating versus not treating the oak woodlands and meadows are analyzed and only the differences in those effects between alternatives are discussed separately by alternative.

Cumulative Effects

Over the last 100-150 years, Oregon white oak woodlands and meadows across the interior valleys of Washington and Oregon have decreased in acres. Many are in a degraded condition. These changes are largely the result of human activities, including Euro-American settlement, conversion to agriculture, livestock grazing, road building, wood cutting, invasion of noxious weeds, and fire exclusion.

Many plants associated with oak woodlands and meadows are short-lived and depend on fire for seed germination or regeneration. These plant communities historically had a fire return interval of 5-15 years and are adapted to frequent, low intensity fire. Excluding fire has resulted in reduced vigor of native species, loss of habitat and plant species diversity, loss of forage areas for deer and elk, and alterations in structure and ecosystem processes. Fire exclusion has also contributed to a build up of unnaturally high fuel levels, which in the event of wildfire may burn at high severity and result in more damage to plants and soil than would occur with lower severity fires.

During the Timbered Rock Fire, five percent of oak woodlands and meadows on BLM-administered land within the fire area burned at high severity, which may have resulted in some damage to native plants and increased the risk of invasion by nonnative plants or noxious weeds. The rest of the oak woodlands and meadows within the fire burned at moderate to very low burn severity, which was within the normal range of historic fire behavior and accomplished some reduction of hazardous fuels and mortality of small diameter conifers.

Under the Timbered Rock ESRP, two management actions were implemented that affect oak woodlands and meadows. Although the effects are analyzed under separate documents, these actions are mentioned because they influence management decisions proposed in this EIS for oak woodlands and meadows.

Cattle grazing in the Elk Creek Watershed will be suspended for at least two years after the Timbered Rock Fire. Removing cattle during this time may benefit oak woodlands and meadows within the fire perimeter by allowing vegetation to recover without the added pressure of grazing.

Surveys for noxious weeds were conducted along the Timbered Rock Fire line in 2003. When noxious weeds were encountered, they were treated. The firelines will be monitored for noxious weeds at least one more year. Because some firelines transected oak woodlands and meadows, noxious weeds may have been introduced or spread in these plant communities during fire suppression activities. Monitoring and treating noxious weeds along the firelines will help prevent or slow the invasion of non-natives.

Post-fire timber harvesting and road building on private land within the fire perimeter could also potentially contribute to the spread of noxious weeds into oak woodlands and meadows on BLM-administered land. BLM roads within the fire perimeter will also be monitored in 2004 for noxious weeds and populations encountered will be treated.

Effects of Alternative A (No Action) on Oak Woodlands and Meadows

- Alternative A would have a neutral to slight negative effect on oak woodland and meadow plant communities in the Elk Creek Watershed because no habitat enhancement, fuels reduction, or noxious weed treatments would be implemented in those habitats inside or outside the fire perimeter.

Salvage

Direct and Indirect Effects

Under Alternative A, no salvage is proposed and no impacts to oak woodlands or meadows would occur as a result of salvage operations.

Restoration

Direct and Indirect Effects

Under Alternative A, no habitat enhancement projects would be implemented in oak woodlands and meadows. No direct effects would occur to vegetation in these plant communities.

Potential indirect negative effects of increasing or spreading noxious weeds during burning would be avoided. However, there would be no positive benefits from treating oak woodlands and meadows. Within the fire perimeter, no maintenance treatment would occur in oak woodlands and meadows that burned in the Timbered Rock Fire. Conditions overall in these habitats were improved as a result of the fire,

but would not be maintained. They would eventually return to conditions similar to those in the oak woodlands and meadows located outside the fire perimeter.

Outside the fire perimeter, Douglas-fir and incense cedar would continue encroaching into oak woodlands, shading out oaks and pines and converting the open oak woodlands to denser mixed hardwood-conifer stands. Fuels would continue to build up, potentially resulting in high intensity, long duration fires in the event of another wildfire. Conifers would continue encroaching into meadows, reducing their extent. Where non-native annual grasses occur and fire is excluded, thatch would continue to build up, shading out native grasses and forbs that might generate under more open conditions. High severity fires could potentially cause mortality or damage to native plants or seeds in the seedbank, or increase the risk of invasion by nonnative plants into these plant communities.

Cumulative Effects

See Cumulative Effects Common to All Alternatives. Current conditions and trends in oak woodlands and meadows would continue under Alternative A. Conditions in these plant communities would not improve.

Effects of Alternative B on Oak Woodlands and Meadows

- Alternative B would provide beneficial effects to oak woodlands and meadows in the Elk Creek Watershed outside the fire perimeter, but no benefits to these plant communities inside the fire perimeter.

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage is proposed and no impacts to oak woodlands or meadows would occur as a result of salvage operations.

Restoration

Direct and Indirect Effects

Under Alternative B, habitat enhancement of oak woodlands and meadows would only occur on 1,003 acres outside the fire perimeter. Treatment of the units would be spread out over five years. Inside the fire perimeter, 540 acres of oak woodlands would not be treated.

There would be short-term direct effects to some vegetation in these plant communities as a result of thinning and underburning. Some shrubs and trees less than 8" DBH would be cut and removed. Plants would be subject to low intensity fire. However, in the long-term these effects are considered beneficial because native plants in these communities are adapted to low intensity fire and the treatment would move these habitats closer to their pre-European structure. Using prescribed fire would reintroduce this natural ecosystem process that maintains these communities and benefits other resources.

Removing small diameter (less than 8") oak, Douglas-fir, and incense cedar would reduce competition for moisture and light for the remaining oaks and pines and allow for their regeneration. Burning through oak woodlands and meadows removes grass thatch and results in a flush of nutrients and renewed vegetative growth of grasses, forbs, and shrubs. Treating these habitats would improve the vigor of native species and increase plant species diversity.

Burning could also result in some potential indirect negative effects by opening up new areas for invasion by nonnative plants or noxious weeds, such as medusahead (*Taeniatherum caput-medusae*), hedgehog dogtail (*Cynosurus echinatus*), or yellow starthistle (*Centaurea solstitialis*). Some native plant species, however, would benefit from low to moderate intensity fire and from opening the canopy.

Replacing all nonnatives with natives and maintaining them over time may not be a practical goal because of the prevalence of nonnative species across the landscape. Focusing on treating noxious weeds and preventing their spread into new areas is a priority that is more attainable and is critical before other treatments are implemented.

Project design features would reduce the risk of spread of noxious weeds and improve the chances of enhancing native vegetation. All areas would be surveyed for Special Status Plants and noxious weed populations prior to treatment. Noxious weed populations would be treated prior to other treatments and monitored to ensure that they remain under control. Native grass seed collected from the Timbered Rock project area, or from similar habitats in neighboring areas, and grown out in nurseries, would be applied to bare dirt exposed during underburning or thinning.

Prescribed fire, used in conjunction with weed treatment prior to burning, seeding with native grass seed after burning, or mulching seed could also be used to enhance native grasses and forbs. Timing and intensity of prescribed burns would vary by area, in relation to habitat conditions, including the proportion of native versus nonnative species present. More than one approach would be needed to reduce the extent of nonnative species and increase natives.

While there is some risk of increasing nonnative grasses and forbs during thinning and burning, the overall benefit of retaining the structure and function of oak woodlands and meadows outweighs those risks. Maintaining these habitats would contribute to biological diversity and improve wildlife habitat.

No pre-fire surveys were conducted in the oak woodlands and meadows to determine the proportion of native versus nonnative species. Current conditions cannot be compared with pre-fire conditions. Prior to the proposed treatments, the project areas would be surveyed for noxious weeds. Any populations discovered would be treated prior to thinning and underburning.

Under Alternative B, no maintenance treatment would be implemented in oak woodlands and meadows that burned in the Timbered Rock Fire. These habitats are currently in good condition, but would not be maintained. With the agency's policy of fire exclusion, oak woodlands and meadows inside the fire perimeter would eventually return to conditions similar to those outside the fire perimeter.

Douglas-fir and incense cedar would continue encroaching into oak woodlands, shading out oaks and pines and converting the open oak woodlands to denser mixed hardwood-conifer stands. Fuels would continue to build up, potentially resulting in high intensity, long duration fires. Conifers would also continue encroaching into meadows, reducing their extent. Where non-native annual grasses occur and fire is excluded, thatch would continue to build up, shading out native grasses and forbs that might generate under more open conditions.High severity fires could potentially cause mortality or damage to native plants or seeds in the seedbank, or increase the risk of invasion by nonnative plants. Nonnative and noxious weed populations could increase in these habitats because no control methods would be applied.

Cumulative Effects

See Cumulative Effects Common to All Alternatives. Activities proposed under Alternative B are not expected to contribute additional negative cumulative effects to oak woodlands and meadows. Reintroducing fire where it has been excluded for the past 100-150 years, treating noxious weed populations, and moving structure toward more historic conditions outside the fire perimeter would improve overall conditions of these plant communities at the stand and landscape levels.

Effects of Alternatives C, D, E, and G (Preferred Alternative) on Oak Woodlands and Meadows

- These alternatives would provide beneficial effects to oak woodlands and meadows in the Elk Creek Watershed because habitat restoration treatments would be implemented in these two plant communities both inside and outside the fire perimeter.

Salvage

Direct and Indirect Effects

No salvage activities would occur in oak woodlands or meadows under these alternatives. There would be no direct effects to these plant communities from salvage operations. There could potentially be indirect effects of spreading or introducing noxious weeds into oak woodlands or meadows during salvage operations in adjacent conifer stands or roads. The risk of these effects would be minimized by implementing project design features, such as washing equipment before entering the project area, monitoring roads for noxious weeds, and treating populations when discovered, as authorized under the district noxious weed program.

Restoration

Direct and Indirect Effects

Alternatives C, D, E, and G propose thinning and underburning in oak woodlands and meadows both inside (540 acres) and outside (1,003 acres) the fire perimeter. Not all oak woodlands and meadows within the watershed were selected to treat and not all areas would be treated at one time. This would allow for a mix of stand ages and conditions across the watershed.

Direct and indirect effects of these treatments in oak woodlands and meadows outside the fire would be the same as those described under Alternative B.

Under these alternatives, treating the oak woodlands and meadows that burned within the Timbered Rock Fire perimeter would maintain the open conditions created by the fire. Sites would be monitored and treatment applied when numerous small conifer, brush, or oak seedlings reappeared. Trees and brush would be manually thinned, piled and burned, and the areas underburned as needed 5-15 years after the fire (2007-2019), which is within the estimated fire return interval. The potential direct and indirect negative and positive effects from these treatments would be the same as those in areas outside the fire, described under Alternative B.

Cumulative Effects

See Cumulative Effects Common to All Alternatives. Activities proposed under these alternatives are not expected

to contribute additional negative cumulative effects to oak woodlands and meadows. Reintroducing fire where it has been excluded for the past 100-150 years, treating noxious weed populations, and moving structure toward more historic conditions in oak woodlands and meadows throughout the watershed would improve overall conditions of these plant communities at both the stand and landscape levels.

Effects of Alternative F on Oak Woodlands and Meadows

- Alternative F would provide beneficial effects to oak woodlands and meadows inside the Timbered Rock Fire perimeter, but no benefits to these plant communities in the rest of the watershed.

Salvage

Direct and Indirect Effects

Under Alternative F, no salvage activities would occur in oak woodlands or meadows in the Elk Creek Watershed. There would be no direct effects to these plant communities from salvage operations. There could be a slight potential of indirect effects of spreading or introducing noxious weeds into oak woodlands or meadows during the course of salvage operations in adjacent conifer stands or roads. The risks of these effects would be minimized by implementing project design features such as washing equipment before entering the project area and monitoring roads for noxious weeds and treating populations as discovered, as authorized under the district noxious weed program.

Restoration

Direct and Indirect Effects

Restoration treatments would be implemented on 540 acres in oak woodlands and meadows within the fire perimeter only. No oak woodlands or meadows outside the fire perimeter would be treated. Potential positive and negative direct and indirect effects from those treatments would be the same as those described under alternatives C, D, E, and G.

Cumulative Effects

See Cumulative Effects Common to All Alternatives. The activities proposed in Alternative F would not contribute additional negative cumulative effects to oak woodlands and meadows in the Elk Creek Watershed. Maintaining these plant communities within the fire perimeter by thinning and underburning and treating noxious weed populations would provide beneficial long-term effects at the stand and watershed levels, but conditions would not be improved in oak woodlands and meadows outside the fire perimeter.

3.8 Special Status Plants

- The project area is outside the known ranges of the T&E species, *Fritillaria gentneri, Lomatium cookii,* and *Limnanthes floccosa* ssp *grandiflora*.
- Seven Special Status vascular plants (one lichen, four bryophytes, and three fungi species) have been documented in the project area.

Special Status plants include vascular plants, lichens, bryophytes, and fungi in the following categories:

- Federally Threatened, Endangered, or Proposed (T&E)
- State Threatened, Endangered, or Proposed
- BLM Sensitive (BSO), Assessment (BAO), Tracking (BTO), or Medford Watch (MW)
- Survey and Manage (S&M) categories A, B, C, D, E, or F

Species in these categories have different pre-disturbance survey requirements, receive different levels of protection, and are managed through various decision documents and regulations. See Appendix L, Botany, for more detailed descriptions of the categories and species.

3.8.1 Methodology

Proposed projects on BLM-administered land are screened prior to implementation to determine what botanical surveys are needed (see Table 3.8-1). A review is conducted to determine if the proposed management action would occur in an area within the ranges and/or potential habitat of the species of concern (T&E, Sensitive, and S&M), and if it would negatively impact populations.

Table 3.8-1. Survey and Protection Guidelines for Special Status Plants

Status	Pre-Disturbance Surveys	Protection
Federal T&E	Yes	Yes
State T&E	Yes	Yes
BSO	Yes	Yes
BAO	Yes	Yes
BTO, MW	No	Discretionary
S&M A, C	Yes	Yes
S&M B, D, E	No	Yes
S&M F	No	Discretionary

Surveys focus on detecting either vascular or non-vascular (lichen and bryophyte) species. All fungi on the Medford District list are Survey and Manage category B, D, or F or Bureau Tracking, which do not require predisturbance surveys. Surveys are conducted by professional botanists

using an intuitive-controlled method, according to established protocols for S&M species (www.or.blm.gov/surveyandmanage). Although no official protocols exist for Special Status plants, surveys follow S&M protocols. The surveyor walks transects across units and concentrates searches in areas of potential habitat for Special Status and S&M species. Vascular plant surveys are conducted between April and August during the appropriate blooming times to detect target species in the habitats surveyed. Surveys for lichens and bryophytes are generally completed between September and May. Some sites are also discovered during the course of other field work and reported as incidental sightings.

A records review was conducted in fall 2002 to determine what Special Status plant species occur or could potentially occur in the Timbered Rock project area and could be affected by proposed projects. In addition to looking at areas within the fire perimeter, areas outside the fire perimeter, but within the Elk Creek Watershed, and 400 feet beyond the watershed boundary, were also evaluated.

Information about Special Status plant species in the Elk Creek Watershed was gathered from Butte Falls Resource Area botanical survey reports. Information for species that could potentially occur in the project area was gathered from the 1996 Elk Creek Watershed Analysis, the 2003 Medford District Special Status Plant list, the Medford BLM Special Status plant species database, *Special Status Plants of the Medford District BLM* (Knight and Seevers 1992), and *A Guide to Rare Plants of the Siskiyou National Forest* (USDA 2000a). Only species documented in the project area or in surrounding watersheds, or having habitats similar to those within the Elk Creek Watershed, are considered as potentially occurring in the project area.

Several plants referred to in the Elk Creek Watershed Analysis and the Lost Creek LSR Assessment as “rare” or “species of concern or interest” are not included in this list because they no longer have special status or were reported on surrounding Umpqua or Rogue River National Forest land and are not expected to occur on BLM-administered land in the LSR (see Appendix L, Botany, Table L-2). Plant communities, habitats, and species in the Elk Creek Watershed differ somewhat from those on National Forest land because they are lower elevation and on mostly drier, south-facing slopes. However, future surveys may discover Special Status species that have not yet been reported in the Elk Creek Watershed.

3.8.1.1 Assumptions

- Even though the Timbered Rock project area is outside the ranges of the three T&E plants in the Butte Falls Resource Area, surveys conducted for sensitive species would detect and document all Special Status vascular plants, if present. The same would be true for non-vascular species. Even though surveys are not required for Bureau Tracking; Medford Watch; and S&M B, D, E, and F categories, surveys that target Bureau Sensitive and Assessment and S&M A and C lichens and bryophytes would detect and document all Special Status non-vascular plants.
- Although the Special Status plant species considered as occurring in and potentially occurring in the project area are limited to those documented in the watershed and surrounding watersheds, or in habitats similar to those within the Elk Creek Watershed, the effects analysis focuses on impacts to habitats and substrates versus species and would apply to other Special Status species that may occur in the project area in similar habitats or on similar substrates.

3.8.2 Affected Environment

The Timbered Rock project area is located on the western slopes of the Cascade Mountains. Elevations range from about 1,400 feet along Elk Creek to 4,600 feet at the top of the watershed. Plant communities in the area include lower elevation oak woodlands, chaparral, meadows, and mixed hardwood-conifer woodlands, as well as upper elevation hardwood-conifer and mixed conifer forested stands. Special habitats include riparian zones and rock outcrops. Although the Elk Creek Watershed contains a mix of habitats, surveys both before and after the Timbered Rock Fire have detected few Special Status or S&M plant species.

Approximately 35 percent of BLM-administered land in the Timbered Rock project area has been surveyed for Special Status vascular plants through fall 2003 (see Appendix L, Botany, Table L-3). Only 3 percent has been surveyed for Special Status and S&M lichens and bryophytes. Since completion of the DEIS, an additional 18 percent of BLM-administered land has been surveyed. It is anticipated additional sites and species would be discovered during surveys in the proposed restoration project areas.

Special Status plants discovered during surveys and from incidental reports are listed in Table 3.8-2 and Table L-4 in Appendix L. See Table L-5 in Appendix L, Botany, for a list of documented and suspected Special Status plant species in the watershed and their typical habitats.

In addition to conducting surveys in the project area for Special Status and S&M species, 14 quadrats were also established within the fire perimeter in areas seeded with native grass and non-native sterile grass seed as part of post-fire rehabilitation. Data was collected to evaluate the effectiveness of the treatment, monitor the persistence of the non-native grasses, and compare plant species composition and diversity in treated and untreated areas. Follow-up data would be collected 2004 and 2005.

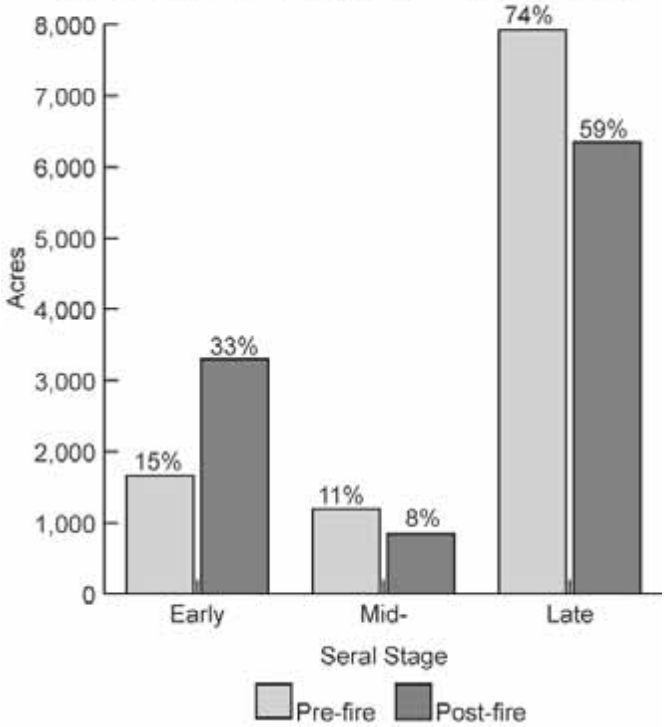
Habitat

The Timbered Rock Fire burned through the Elk Creek Watershed between July 13 and September 14, 2002. Of 11,774 acres of BLM-administered land within the fire perimeter, only 8 percent burned at high severity. Approximately 15 percent of late seral and 3 percent of mid-seral stage conifer stands on BLM-administered land within the fire perimeter were returned to an early seral stage as a result of the fire (see Figure 3.8-1).

Table 3.8-2. Special Status Plants Documented in the Timbered Rock Project Area

Scientific Name	Common Name	Status	Number of Sites
Vascular Plants			
Cimicifuga elata	tall bugbane	Bureau Sensitive	1
Cypripedium fasciculatum	clustered ladyslipper	Bureau Sensitive, S&M C	8
Cypripedium montanum	mountain ladyslipper	Bureau Tracking, S&M C	6
Iliamna latibracteata	California's wild hollyhock	Bureau Assessment	3
Limnanthes floccosa ssp *bellingeriana*	Bellinger's meadowfoam	Bureau Sensitive	2
Perideriia howellii	Howell's uampah	Bureau Tracking	1
Sedum spathulifolium ssp *purdyi*	Purdy's stonecrop	Bureau Tracking	1
Lichens			
Sulcaria badia	grooved horsehair lichen	Bureau Sensitive	1
Bryophytes			
Fabronia pussila	fabronia moss	Bureau Tracking	1
Funaria muhlenbergii	Muhlenberg's funaria moss	Bureau Assessment	1
Tortula subulata	awl-leaved tortula moss	Bureau Tracking	2
Tripterocladium leucocladulum	tripterocladium moss	Bureau Assessment	1
Fungi			
Cortinarius olympianus		S&M B	1
Plectania milleri		Bureau Tracking	1
Ramaria rubripermanens		S&M D	2
Tremiscus helvelloides	apricot jelly mushroom	S&M D	1

Figure 3.8-1. Pre- and Post-fire Seral Stages of Conifer Stands within the Fire Perimeter



At the watershed level, late seral conifer stands on BLM-administered land dropped from 75 percent to 68 percent after the fire (see Figure 3.8-2). The fire burned in a patchy pattern, leaving a landscape with various seral stages and habitats.

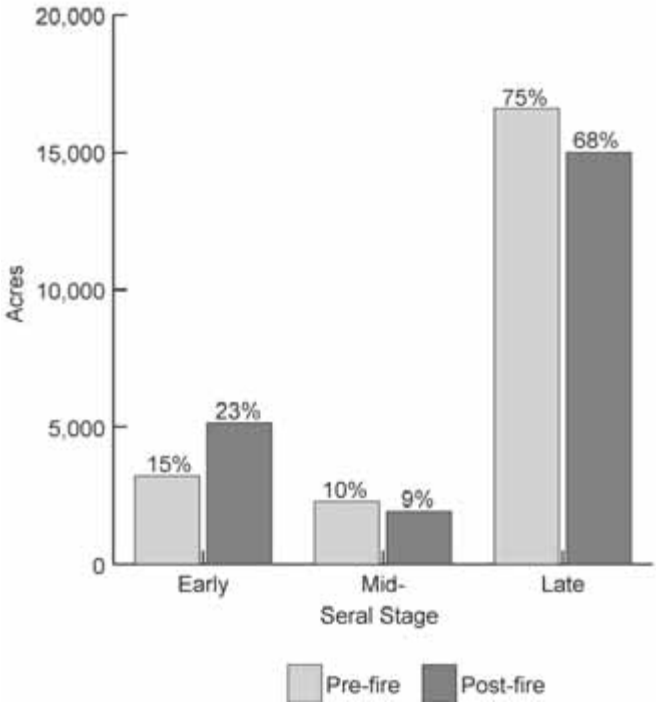
In addition to habitat alteration that occurred as a result of the fire, some disturbance was also caused by fire suppression activities on BLM-administered land, including construction of 7.7 miles of tractor line, 3.6 miles of handline, and two staging areas. This disturbance may have impacted some Special Status plants, although the risk of adverse effects is low given the scale of the disturbance.

Although management for late-successional and old-growth associated species is a priority in the Elk Creek LSR (USDI 1995, 32), habitat also exists for Special Status plants not associated with old-growth or in special habitats within old-growth habitat. Some Special Status plants are associated with small gaps in the forest or early seral forest conditions created by natural disturbances, such as fire or trees falling. Other species occupy unique habitats, such as rock outcrops, scablands, riparian areas, wetlands, seeps, or moist meadows.

3.8.2.1 Vascular Plants

Vascular plant surveys were conducted in proposed salvage units in summer 2003. Vascular plant surveys would also be conducted in restoration project areas prior to

Figure 3.8-2. Pre- and Post-fire Seral Stages of Conifer Stands on BLM-administered Lands within the Watershed



implementation, except for road projects limited to existing road prisms. These surveys are triggered by the potential occurrence of Sensitive, Assessment, or S&M category A or C vascular plants and anticipated disturbance from the proposed activities that could impact populations.

Threatened and Endangered Plants

Three Endangered plants have ranges within the Butte Falls Resource Area - *Fritillaria gentneri*, *Lomatium cookii*, and *Limnanthes floccosa* ssp *grandiflora*. The ranges of all three T&E species are outside the Elk Creek Watershed and the Timbered Rock project area (see Map 3-13).

In addition to surveys conducted on approximately 8,000 acres of BLM-administered land in the Elk Creek Watershed, 168 acres of suitable habitat on USACE land were surveyed in 2001 and 2002 specifically for *Fritillaria gentneri*. No T&E plant sites have been detected within the project area.

Special Status Vascular Plants

The Medford District Special Status Plant list contains 189 vascular plants documented or suspected to occur on BLM-administered land within the District; 48 of those have been discovered in the Butte Falls Resource Area.

Seven Special Status vascular plants have been discovered to date in the Timbered Rock project area (see Table 3.8-2 and Appendix L, Botany, Table L-4): *Cimicifuga elata*, *Cypripedium fasciculatum*, *Cypripedium montanum*, *Iliamna latibracteata*, *Limnanthes floccosa* ssp *bellingeriana*, *Perideridia howellii*, and *Sedum spathulifolium* ssp *purdyi*. Six sites occur in proposed treatment units. Five new sites of three Special Status species were discovered during the vascular plant surveys in summer 2003 (see Appendix L for species descriptions and general locations of sites). It is anticipated that additional sites would be located during future surveys in proposed restoration projects. When discovered, these sites would be managed consistent with existing protocols.

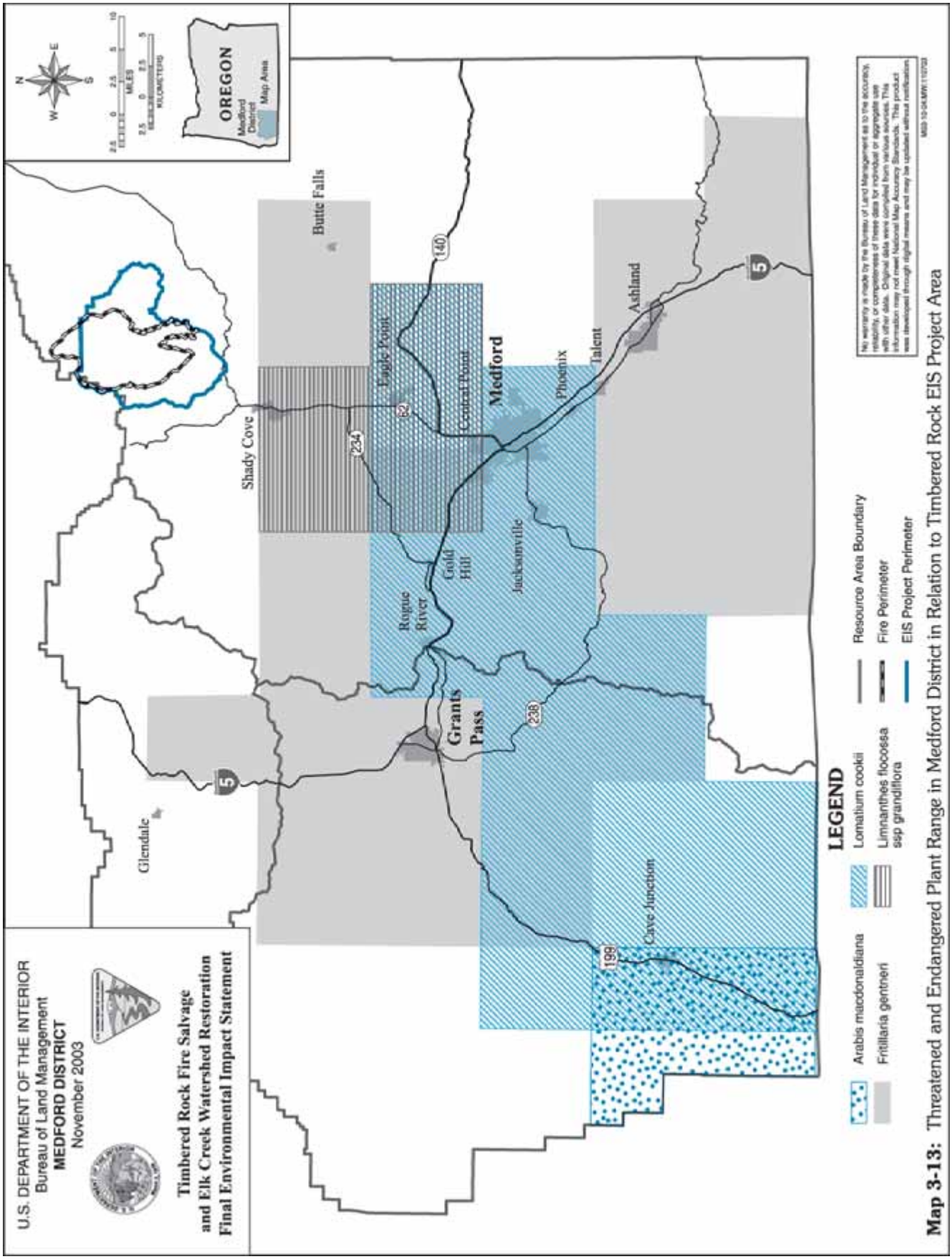
Many native vascular plants are adapted to frequent fire regimes. Some depend on fire for seed germination or for creating openings for regeneration. Most native plants, including some Special Status species, will recover naturally over time in areas of the Timbered Rock Fire burned at low and moderate severity. In areas burned at higher severity, flames and/or heat of the fire may have destroyed perennial bulbs, roots, or seeds stored in the soil. In severely burned mature stands, canopy removal, potential soil erosion, and subsequent invasion by nonnative plant species could hinder the survival or reestablishment of Special Status species. Some species may not have been completely killed by the fire, but will take one or more years to recuperate from the fire. These plants may not be detected in the first blooming season after the fire.

Two Special Status vascular plant sites documented within the fire perimeter prior to the Timbered Rock Fire were revisited in summer 2003. One site of *Cypripedium montanum* had no evidence of plants, although eight were observed in 2001. The area burned at low severity, but the microsite where the plants were located burned at a higher intensity. The site will be revisited in 2004. The *Sedum spathulifolium* ssp *purdyi* site burned at low severity and there was no evidence of damage to the plants.

Optimal conditions for Special Status vascular plants are provided by ecosystems with a diversity of habitats and properly functioning natural processes. The Timbered Rock Fire reintroduced fire into the plant communities within the fire perimeter. Some late-successional habitat for old-growth dependent species was lost, but early seral conditions that would benefit species associated with earlier seral conditions or disturbance events increased. Overall, the patchiness of post-fire conditions on BLM-administered land in the Elk Creek Watershed supports populations of Special Status vascular plants.

3.8.2.2 Lichens and Bryophytes

The Medford District Special Status list contains 21 Special Status and S&M lichens, 21 bryophytes, and 1 liverwort. Of those, 12 lichens and 8 bryophytes have been discovered in the Butte Falls Resource Area. To date, all Special Status and S&M lichens and bryophytes that have been documented in



Map 3-13: Threatened and Endangered Plant Range in Medford District in Relation to Timbered Rock EIS Project Area

the Elk Creek Watershed occur on rock, soil, or hardwoods, none use conifers for substrate.

Limited surveys for lichens and bryophytes were conducted on BLM-administered land in the Elk Creek Watershed prior to the Timbered Rock Fire and it is unknown how many sites of Special Status or S&M species may have existed before the fire. One lichen species and four bryophyte species have been discovered in the Elk Creek Watershed as of October 2003 (see Table 3.8-2 and Table L-4 in Appendix L).

Non-vascular plant surveys for Special Status lichens and bryophytes were not required in salvage units burned at high and moderate severity because they did not survive where the duff layer was consumed and host trees burned. However, surveys for non-vascular species were conducted in three research units and in areas where helicopter landings and temporary roads were proposed. No Special Status or S&M species were discovered. In fact few lichens or bryophytes were observed in any proposed salvage units.

Surveys for Special Status and S&M lichens and bryophytes would be completed in restoration projects prior to their implementation, except for road projects in existing road beds and in conifer stands younger than 40 years. The surveys are triggered by the potential occurrence of Sensitive, Assessment, or S&M category A or C lichens and bryophytes and anticipated disturbance that could impact populations. Conifer stands younger than 40 years would not be surveyed because it is expected to take that length of time after a stand-replacing disturbance (e.g. timber harvest or fire) for development of a diverse lichen and bryophyte flora that could potentially include rarer species.

One Special Status lichen discovered in the project area, *Sulcaria badia*, occurs on Oregon white oak trees in a pine habitat restoration unit. Two Special Status bryophytes, *Funaria muhlenbergii* and *Fabronia pussila*, were discovered on the east side of the project area in eagle habitat restoration units. *Funaria muhlenbergii* grows on soil and *Fabronia pussila* grows on rock outcrops.

If Special Status lichens or bryophytes were present in the Timbered Rock Fire area prior to the fire, they likely suffered direct damage from flames, heat, or smoke, or indirect damage from loss of substrate, although they may have received less damage because the fire occurred in late summer when they were dry and dormant (USDA and USDI 2002, 13). In areas that burned at high and moderate severity, there was considerable tree mortality and the duff layer was completely consumed. Lichens and bryophytes occurring on soil or rock or on trees with no live canopy, burned and suffered complete mortality.

Because lichens and bryophytes grow very slowly and depend on moist conditions for food production and reproduction, they take longer to recover from fire than vascular plants. Recovery will depend on available suitable substrate and source material. Lichens recolonize by spreading spores or fragments of surviving thalli (lichen body). Bryophytes recolonize by spreading spores produced in capsules. Fragile spores and algal components required for regeneration of bryophytes and lichens did not likely survive the fire and heat in the Timbered Rock Fire. Recolonization in moderate and high severity areas would come from source material in surrounding unburned or less intensely burned areas.

Because the Timbered Rock Fire burned in a patchy pattern, source material is probably present in unburned stands, in stands that burned at low severity, and possibly even in tree tops in some moderate burn severity areas in pockets that burned at lower severity. The checkerboard ownership in the Elk Creek Watershed and the extensive harvesting of trees on private land limits the amount of potential source material and connectivity between unburned stands that could facilitate recolonization between source patches.

Some bryophytes and lichens are early seral colonizers and will develop rapidly on the nutrient-rich post-fire soil in the Timbered Rock Fire area. These early seral lichens and bryophytes do not include Special Status or Survey and Manage species. Three months after the fire was controlled, new growth of a soil bryophyte species was observed in an early seral plantation burned at high severity and in an oak woodland burned at moderate severity (Wineteer 2003). These early seral bryophytes may provide some protection against erosion of exposed soil.

Plant communities found in the Elk Creek Watershed, particularly the southern part, have historically experienced frequent fire return intervals. Although information is limited on the effects of fire on lichens and bryophytes, it is likely many species in these habitats are adapted to frequent fire regimes and have strategies for reestablishing after fire.

3.8.2.3 Fungi

Fungi are not plants or animals, but belong in a separate kingdom. They fill important roles in forest ecosystems, including decomposition and nutrient recycling. Many fungi have symbiotic relationships with tree and other vascular plant species. The fungi provide increased amounts of water and nutrients to the plants and the plants provide food in the form of carbohydrates to the fungi. The main body of a fungal individual consists not of the fruiting body, or mushroom, but rather a network of underground mycelium associated with living plant parts, decaying wood, or soil.

The 49 fungi on the Medford Special Status list are Bureau Tracking or S&M category B, D, or F and no pre-disturbance surveys are required for them. However, when S&M fungi are discovered during Strategic Surveys or incidental encounters, sites in categories A, B, C, D, and E are

protected. Protection of Bureau Tracking and S&M category F fungi is discretionary.

Three fungi survey efforts have been conducted in the Elk Creek Watershed, resulting in discovery of four species currently on the S&M or Special Status list. The first two survey efforts occurred in November 1998 and April 1999 by an S&M fungi taxa group from Oregon State University led by Dr. Thomas O'Dell. Fungi specimens were collected from old-growth stands in Sugarpine, Hawk, and Elkhorn creeks and on USACE land along the main branch of Elk Creek. Of the twelve S&M fungi species discovered during the surveys, only two, *Ramaria rubripermanens* (S&M D), documented on USACE land, and *Plectania milleri* (BTO), on BLM-administered land, still have S&M status.

The third fungi survey focused on detecting specific genera and was conducted in 2001 on 138 acres in 3 different units in the LSR. Of 138 acres surveyed, two units (83 acres) were outside the fire area and one unit (15 acres) was inside the fire perimeter. Two S&M species discovered during this survey - *Cortinarius olympianus* (S&M B) and *Tremiscus helvelloides*, also known as *Phologiotis helvelloides* (S&M D) were located outside the fire perimeter.

Although few acres have been surveyed for fungi in the Elk Creek Watershed, it is assumed more S&M and Special Status fungi are probably present, both inside and outside the fire perimeter.

The survival of S&M or Special Status fungi in fire burned areas is unknown. Fungi in areas burned at high severity are most likely to have experienced more long-term damage through mortality of host trees; complete consumption of litter, duff, and woody debris; and scorched soil layers. Low intensity fires may be beneficial in the long-term by creating habitat patches that promote species diversity in ecosystems with historically short fire return intervals (USDA and USDI 2002a, 7, 9).

Many fungi are negatively affected by fire and disappear until site conditions are favorable for recolonization of the species. Some fungi taxa, however, respond to the flush of nutrients into the soil after fire by producing large amounts of fruiting bodies (mushrooms) for one to three years. Morels, in particular, fruit abundantly after fire, are a choice edible mushroom, and are documented in the Butte Falls Resource Area.

The effects on long-term viability of fungi from harvest are unknown. Removing mushrooms is comparable to picking apples and does not harm the main body of the fungi, which is underground. The mushroom is the reproductive structure of the fungi and produces spores which germinate to produce new fungi and contribute genetic diversity to the population (Parks and Schmitt 1997, 10). There is no evidence that picking mushrooms would result in decreased production or reduced population viability. Pickers generally select mushrooms not fully mature. Since spores are released only from mature mushrooms and maturation does not happen all at once, it is unlikely that pickers would collect 100 percent of the mushrooms from any individual population.

3.8.3 Environmental Consequences

- The proposed projects would be "no effect" to the Endangered plants *Fritillaria gentneri, Limnanthes floccosa* ssp *grandiflora*, and *Lomatium cookii*.
- No proposed projects would lead to a need to list any Special Status plants or jeopardize the persistence of S&M plant species.

Surveys have been conducted for Special Status vascular plants in proposed salvage units and some LSR thin, riparian thin, and FMZ units. Vascular and non-vascular plant surveys were completed in all areas proposed for helicopter landings and temporary road construction. Surveys for Special Status lichens and bryophytes were also conducted on approximately 120 acres in three proposed research units. See Table L-3 in Appendix L for a summary of surveys completed through October 2003 in the Timbered Rock Project Area. Surveys for Special Status vascular plants, lichens, and bryophytes would be conducted in restoration project areas prior to their implementation. Survey rationales are discussed in Section 3.8.1. Special Status species that are documented in project areas would be protected based on the species, site conditions, and proposed activities. See Table L-4 in Appendix L for a summary of protection measures. Surveys are not required for Special Status or S&M fungi.

Effects of the proposed activities are considered on the species that have been documented to date in the project area (see Table 3.8-2). However, effects are described in terms of substrates or habitats and would apply to Special Status species associated with those substrates or habitats that would be discovered in future surveys in the project area.

Potential effects applicable to all alternatives are discussed at the beginning of the vascular plant and the lichen and bryophyte sections and are not carried through all alternatives. Benefits to Special Status plants from the proposed actions are also discussed, as are cumulative effects beyond the control of the government that may adversely impact Special Status plants. Only those effects that would vary by alternative are discussed by alternative.

Protection Measures

Protection measures are implemented to conserve T&E species and populations, ensure that actions authorized, funded or carried out by the BLM do not contribute to the need to list any Sensitive or Assessment plant species (USDI 2001), and manage known sites of S&M species in

categories A-E. Protection measures for S&M species follow management recommendations, where available. Protection of Bureau Tracking, Medford Watch, and S&M category F species is not required, but is discretionary. Species in those categories for which few sites are known are generally protected.

Protection measures are developed utilizing existing management recommendations developed by taxa experts and adopted by the BLM and US Forest Service, other reference sources, and professional knowledge of the species and the resource area. Buffer sizes are determined by considering the proposed treatment, the environmental requirements of the species, and the ecological conditions of the site, including plant community, aspect, slope, and canopy closure.

Protecting plants from direct impacts is the first priority. For some species, maintaining canopy cover and microsite conditions is also important and buffers are established around the plant site. Other species and sites may not be negatively affected by and may even benefit in the long-term from pro-active management during periods of dormancy or senescence, such as fall burning or thinning that would enhance habitat or reduce competition from brush, trees, or other herbaceous species. In these instances, smaller buffers or delaying management activities until plants are dormant would be adequate protection. Only sites within treatment units would be buffered.

See Appendix L, Botany, Table L-4 for special status plants documented in the project area, locations, and protection measures.

3.8.3.1 Vascular Plants

Threatened and Endangered Plants

The project area is located entirely outside the ranges of the three Endangered plant species in the Butte Falls Resource Area, *Fritillaria gentneri*, *Lomatium cookii*, and *Limnanthes floccosa* ssp *grandiflora*. No sites for these species have been discovered to date in the Elk Creek Watershed. If any sites are discovered during surveys in proposed restoration projects or from incidental encounters, they would be protected according to management guidelines outlined in the 2004-2008 Programmatic Consultation and Biological Opinion #1-14-03-F-511.

The salvage and restoration projects proposed in Alternatives B through G would have “no effect” on these three Endangered plant species.

Special Status Vascular Plants

Salvage and restoration projects would not result in a need to list any Special Status vascular plants because project areas would be surveyed and sites protected as required. However, some actions may present potential risks to individual plants or may reduce habitat suitability. These risks are described below and compared by alternative.

Effects Common to All Alternatives

Salvage

Direct and Indirect Effects

Two Special Status vascular plant sites have been documented in salvage units (see Appendix L, Botany, Table L-4). One *Cypripedium montanum* site is located in a tractor harvest salvage unit and will be protected with a 100' no-enter buffer. The buffer will prevent direct impacts to the plants and soil disturbance and maintain coarse wood around the site. Although not all trees within the buffer are alive, mycorrhizal fungi that may be associated with the orchid and surrounding trees would be protected from disturbance. One *Iliamna latibracteata* site was discovered in a control research unit where no salvage would occur. Plants in this site would not be impacted. No direct effects from salvage operations would occur to either of these Special Status plant populations.

Data collected during the surveys provides an indirect beneficial effect for Special Status vascular plants by increasing knowledge about the ranges, distribution, and abundance of species in the Butte Falls Resource Area.

The benefits of snags and coarse woody debris (CWD) to vascular plants are not well-described and guidelines for recommended leave amounts have not been established. Fire-killed trees provide a very small amount of shade. However, some plants, including *Cypripedium fasciculatum* and *Cypripedium montanum*, have close relationships with mycorrhizal fungi (USDA and USDI 1998a, 9-8 and 9, 10- 7 and 8), especially during development. Their associations with other fungi is not known, but management recommendations for both species include maintaining coarse, woody material and providing for future recruitment of coarse woody debris (snags) in their habitat (USDA and USDI 1998a, 9-17, 10-14). Other Special Status vascular plants may have similar requirements. Under each alternative, some level of standing fire-killed trees and downed coarse wood would remain after salvage. In the absence of specific CWD and snag guidelines for vascular plants, it is assumed that the models used in Alternatives B-G to determine amounts needed for late-successional associated species, would also provide adequate CWD for fungal associations with vascular plants.

The introduction or spread of noxious weed seed during salvage operations could have an indirect effect on Special Status plants. Noxious weeds may compete with Special Status plants for resources or may degrade habitat. Noxious weeds are generally less of a problem in forested areas than more open habitats over the long-term because they are

shaded out and decrease in numbers as conifers mature and create canopy overstory. Recently burned areas, especially those that burned at high and moderate severity, are at risk in the short-term from invasion by noxious weeds because they are recently disturbed and have lost ground cover and because noxious weeds establish quickly after disturbance.

Noxious weed seed could be introduced or spread by equipment used in logging operations. Especially vulnerable are newly constructed temporary roads and tractor logged units because soil would be disturbed. Project design features would minimize the introduction and spread of noxious weeds during salvage activities. Washing equipment before use in the project area, seeding temporary roads with native grass seed, planting them with conifers, and using certified weed-free grass seed and straw would reduce the spread of noxious weeds into the logged areas.

Some Special Status vascular plants may take more than one year to recover in areas that burned at high to moderate severity. There is a slight possibility that some plants in the salvage units may not have been detected during the 2003 surveys and could be directly impacted by ground-disturbing salvage activities, including temporary road construction and tractor, bull-line, and cable logging. The chance of these impacts occurring increases with an increase in acres treated and feet of temporary road constructed. The following effects could potentially apply to Special Status plants that may not have been detected during 2003 surveys.

Helicopter logging would not likely impact Special Status plants. Fire-killed trees would be felled, attached to cables and flown by helicopter to designated landings. There may be some short-term ground disturbance when the trees are felled and hit the ground. However, the soil disturbance would not be deep or long-term and would not likely impact seeds, roots, or bulbs of Special Status plants. Helicopter rotor blades could potentially spread noxious weed seed around landings, if populations were present on the landings prior to harvest activities.

Bull-line and cable logging could create some soil disturbance from logs being dragged across the ground. Repetitive runs across an area could create troughs where upper soil levels are disturbed. The percentage of ground within each unit impacted by cable logging is small. The risk would be very small of impacting Special Status vascular plants that may have been dormant and not detected during pre-project surveys. This risk would not be considered critical and is not analyzed across the alternatives.

Tractor logging and temporary road construction have the greatest potential for impacting Special Status vascular plants that may be dormant after the fire. Skid trails and temporary roads would be ripped. Seeds, bulbs, or roots of dormant plants could be damaged as a result of soil compaction or displacement during temporary road building, harvest activities, or decommissioning of temporary roads.
Four Special Status vascular plants occur in forest habitats and have been documented in the project area. *Cimicifuga elata* is a perennial plant that has only been located in one site. The population is large, covering several acres on a moist north-facing slope along the Umpqua Divide. The species responds favorably to fire or other disturbances that create canopy openings (Kaye 2000b). If additional sites existed in the salvage units, it is likely they would have been detected during surveys because the plants are large (2-4 feet high) perennials that usually occur in large populations.

Iliamna latibtracteata may also respond positively to fire and disturbance (Center for Plant Conservation 2003, 1) and is also likely to be detected after fire, as indicated by discovery of one population in a high severity burn area. The other two plants, *Cypripedium fasciculatum* and *Cypripedium montanum* may take longer to recover from fire (USDA and USDI 1998a, 9-14, 10-12; Applegate 2002) and would be the most likely to be impacted by tractor logging and temporary road construction if they were not detected prior to harvest.

Restoration

Direct and Indirect Effects

Restoration projects would have no direct effects on Special Status or S&M vascular plants because project areas would be surveyed prior to implementation and sites protected as required. Eight Special Status vascular plant sites have been discovered to date in restoration project areas. See Table L-4 in Appendix L for known Special Status plant sites in restoration projects and protection measures.

Data collected during the pre-project surveys would provide indirect beneficial effects for Special Status vascular plants by increasing knowledge about the ranges, distribution, and abundance of species in the Butte Falls Resource Area.

Habitat restoration and fuels reduction projects would indirectly benefit Special Status vascular plants by improving habitat complexity, promoting habitat diversity, and reducing high fuel loads within the watershed. Accelerating development of late-successional characteristics would benefit species associated with later seral habitat, such as *Cypripedium fasciculatum* and *Cypripedium montanum*. Thinning dense young conifer stands, mixed hardwood-conifer woodlands, oak woodlands, and meadows would open up the understory and provide more light and resources for herbaceous plants, which would increase species diversity. These projects would benefit species associated with more open conditions, such as *Iliamna latibracteata*.

Some restoration projects could potentially indirectly impact Special Status vascular plants by introducing or spreading noxious weeds, which may reduce suitable habitat or compete with Special Status vascular plants for water, light, or nutrients. Noxious weed seed could be introduced

or spread by equipment used in restoration projects that commercially remove some thinned trees. Road work, pump chance reconstruction, or fish habitat improvement projects involving culvert replacement in which soil is disturbed along existing roads or new material is brought in could open up new areas to invasion, or introduce or spread existing weed seed via equipment or imported material. The chance of this occurring corresponds to an increase in treated acres.

Although there may potentially be some short-term effects from restoration projects, the long-term benefits to Special Status plants would outweigh the short-term risks. Project design features would minimize potential impacts from noxious weeds. Washing equipment before use in the project area, seeding ripped roads with native grass seed, and using certified weed-free grass seed and straw would reduce the chances of noxious weeds spreading along road systems.

Road restoration projects could benefit Special Status plants because they would prevent erosion that could directly impact plants or indirectly affect them by creating an avenue for weeds to spread into the interior. Road decommissioning would provide long-term benefits to Special Status plants by removing traffic, breaking up compacted soil, and rehabilitating the ground.

Fish habitat improvement projects, pump chance reconstruction, rock quarry closure and rehabilitation, and road projects would otherwise have a neutral effect to Special Status plants because all areas would be surveyed prior to work. Any sites discovered would be protected as required.

Cumulative Effects Common to All Alternatives

Between July 13 and September 14, 2002, the Timbered Rock Fire burned 27,100 acres across all land ownerships in the Elk Creek Watershed; 2,798 acres (10 percent) at high severity and 7,862 acres (29 percent) at moderate severity. Of 11,774 acres of BLM-administered land within the fire perimeter, only 8 percent burned at high severity.

Approximately 15 percent of late seral and 3 percent of mid-seral stage conifer stands on BLM-administered land within the fire perimeter were returned to an early seral stage as a result of the fire (see Figure 3.8-1).

At the watershed level, late seral conifer stands on BLM-administered land dropped from 75 percent to 68 percent after the fire (see Figure 3.8-2). The fire burned in a patchy pattern, leaving a landscape with various seral stages and habitats.

In addition to habitat alteration that occurred as a result of the fire, some disturbance was also caused by fire suppression activities on BLM-administered land, including construction of 7.7 miles of tractor line, 3.6 miles of handline, and two staging areas. This disturbance may have impacted some Special Status plants, although the risk of adverse effects is low given the scale of the disturbance.

Other fires that burned in 2002 in the vicinity of the Timbered Rock Fire included two within the Butte Falls Resource Area - the Wall Creek Fire (313 acres), west of Timbered Rock, and the Berry Rock Fire (34 acres), just south of Timbered Rock and within the Elk Creek Watershed. Several fires in the Umpqua National Forest (88,000 acres), north of Timbered Rock also burned in 2002. The result of all of these fires was loss of some late seral habitat - 15 percent in Timbered Rock on BLM-administered land and 4.6 percent in the Umpqua National Forest fires (USDA 2003, 51). All fires burned at variable fire severities - 39 percent at high to moderate severity in the Timbered Rock Fire, 46 percent in the Wall Creek Fire, and between 25 and 39 percent (8 percent in one small watershed) in the Umpqua National Forest fires (USDA 2003, 20). The Berry Rock Fire burned at low severity and there was no loss of late seral habitat.

There may have been some mortality of Special Status plants located in areas that burned at high severity. Species that depend on earlier seral conditions may have benefited from these fires, while those associated with later seral conditions may have been negatively affected. It is unlikely the fires that occurred in 2002 in this area of the Rogue-Umpqua Divide jeopardized the species persistence of any Special Status plants. The rare plants that may have been affected by the fires in the Umpqua National Forest Fires are not the same Special Status plant species that occur in the Elk Creek Watershed. The fires that burned in this region of southwestern Oregon were probably overall beneficial to Special Status plants because they reintroduced fire into ecosystems adapted to fire, created patchy, diverse habitats, and initiated succession on which some Special Status plants rely.

Fire suppression activities may have impacted Special Status plant populations. Construction of dozer lines, handlines, and staging areas may have directly disturbed plants. Equipment used during fire suppression efforts came from different parts of the United States and were not washed to remove noxious weed seeds prior to use. Staging areas and roadsides in the fire area contain populations of yellow starthistle, Scotch and Spanish broom, skeleton weed, and Canada and bull thistle. Fire suppression and rehabilitation activities occurred when seeds were mature and easily dispersed. It is likely that fire equipment spread some noxious weed seed into areas that did not contain them prior to the fire. Noxious weeds could impact Special Status plants by crowding them out, competing with them for light and moisture, and degrading suitable habitat.

The area disturbed by fire suppression activities consists of a relatively small proportion of total acres within the

watershed. Constructed dozer lines on the fire were 22.6 miles total and 7.7 miles on BLM. Hand lines totaled 9.8 miles with 3.6 miles on BLM. In addition to new dozer lines, some overgrown roads were opened during fire suppression efforts.

Off Highway Vehicle (OHV) use in the Timbered Rock Fire area could increase as a result of these newly opened roads. OHVs could spread noxious weeds into areas not currently occupied. Dozer lines were checked in 2003 for noxious weeds and populations were treated as discovered.

Some post-fire rehabilitation activities could potentially impact Special Status plants, although the effect of most work is neutral to beneficial. Dozer lines were rehabilitated after the fire, including seeding with native and sterile grass seed. Some high severity burn areas were also seeded with native and sterile grass seed. Study plots established in burned areas on the Siskiyou National Forest that were seeded with approximately 24 pounds per acre of annual grasses, were found to experience slower recovery of native herbaceous vegetation than untreated areas (Amaranthus 1990, 2 and 6). However, seeding on the Timbered Rock Fire was at a rate of 5 to 10 pounds per acre.

There is some chance the grasses that were seeded within the fire area could compete with and suppress Special Status plants. However, they also contribute benefits of preventing soil erosion and competing with nonnative plants. Qualitative observations in 2003 indicated that the seeded grasses did not interfere with native plant recovery. Monitoring has been initiated in the seeded areas under the Timbered Rock Emergency Stabilization and Rehabilitation Plan and will provide quantitative comparisons between seeded and unseeded areas and effects on species composition. If Special Status plants are discovered in seeded areas, they would be monitored to ensure that they are not negatively affected by the grasses.

There has been a loss or alteration of all habitat types throughout the Elk Creek Watershed due to past management actions, including logging, road building, conversion to agriculture, and development. It can be assumed these activities will continue in the future on private lands. Special Status plants receive no protection on private land, which makes up 37 percent of the watershed. Ownership in the Elk Creek Watershed is checkerboard. Many mature forests with structural complexity and species diversity have been converted to single-age early seral stands. In addition to directly impacting Special Status plants, potential effects of these actions include habitat fragmentation and isolation of populations, reduced gene flow, and loss of species diversity.

Logging, road building, and post-fire planting have already occurred or will occur by the end of 2003 on approximately 6,000 acres of industrial forest land in the Elk Creek Watershed. Many of the roads used during these activities pass through BLM-administered land. Noxious weed seed may be spread along BLM-administered roads, resulting in new or increased populations. These populations could spread into adjacent areas and compete with Special Status plant populations.

Fire exclusion over the last 100 years has resulted in altered habitats due to changes in fire regimes and ecosystem processes. Fire burns unequally over a landscape, creating structural complexity which encourages biodiversity (The National Academies 2000, 121). As fuels build up, the risk increases of high severity fires which could result in mortality or damage to Special Status plants. Special Status plants that require disturbance openings or earlier seral stages, or depend on heat or chemicals that fire generates for seed germination, may have declined as a result of fire exclusion.

Commercial timber companies use herbicides to control brush growth, particularly in replanted burned areas. Because of the checkerboard land ownership pattern in the Timbered Rock project area, there is a slight chance that these herbicides could drift onto BLM-administered land and cause mortality or damage to Special Status plants. The area potentially affected by this drift would likely only be a narrow strip along the property line between BLM and industrial forest lands.

Timber sale and fuels treatment projects on approximately 8,000 acres have been completed, nearly completed, or are in the planning stages in two watersheds adjacent to the Elk Creek Watershed. All units in those project areas were surveyed for Special Status plants and noxious weeds prior to treatment. Special Status plant sites that were discovered during surveys have been protected as required.

These management treatments in unburned stands do result in habitat changes, primarily with reductions in closed canopy forested stands. Care is taken to protect individual populations and ensure that species persistence would not be jeopardized for the species documented in the project area. Although there would be a reduction in late seral conifer stands on Matrix land, the NFP and Medford RMP provide a reserve system across the landscape for protection and expansion of Special Status plants associated with late seral habitat.

Table 3.8-3. Comparison by Alternative of Salvage and Restoration Projects Potentially Affecting Special Status Vascular Plants

Indicators	Alternatives						
	A	B	C	D	E	F	G
Acres of tractor harvest in salvage units			21	112	165	29	113
Acres of tractor harvest in restoration projects	0	0	234	234	484	0	234
Miles of temporary roads built	0	0	.25	.6	1.5	0	.85
Miles of road reconstruction	0	2.6	2.6	2.6	2.6	2.6	2.6
Number of culvert replacement sites	0	19	15	15	30	30	15
Miles of roads decommissioned	0	35	35	35	43	17	35
Miles of road maintenance	0	100	100	100	115	68	100
Acres of habitat enhancement projects	0	2,378	4,024	4,024	6,577	540	4,024
Acres of reforestation	6,000	1,992	2,152	2,152	6,000	1,045	2,152
Acres of fuels reduction projects	0	4,223	5,869	5,869	8,422	1,340	5,869

Comparison of Effects to Special Status Plants by Alternative

Table 3.8-3 compares indicators of potential impacts to Special Status vascular plants from salvage and restoration projects in Alternatives A-G. The potential effects from these indicators are discussed by alternative.

Effects of Alternative A (No Action) on Vascular Plants

- Alternative A would not contribute to the need to list any Special Status vascular plants or jeopardize species persistence of any Survey and Manage vascular plants.
- There would be no impacts from salvage or restoration activities, but no benefits from habitat enhancement or fuels reduction projects.

Salvage

Direct and Indirect Effects

Under Alternative A, no salvage would occur. Roadside hazard trees would be felled as needed under separate NEPA documentation. No direct or indirect impacts from salvage operations would occur to Special Status plants.

Restoration

Direct and Indirect Effects

No restoration projects are proposed under Alternative A. There would be no risk of impacts under this alternative to Special Status vascular plants, but there may be a neutral to slightly negative effect on Special Status vascular plants because habitat enhancement projects would not be implemented. Vegetation treatments aimed at promoting late seral conditions in conifer stands and Riparian Reserves (thinning and planting) could benefit Special Status plants associated with these habitats. The sooner these habitats return to late seral conditions, the sooner they will provide habitat for late seral species. Special Status vascular plants associated with oak woodlands, meadows, and open pine stands would not benefit from restoration projects that are designed to create or maintain habitat diversity within those habitats. High levels of hazardous fuels would not be reduced under this alternative, leaving areas and resources in the watershed vulnerable to damage from high severity burns, in the event of another wildfire.

Cumulative Effects

Cumulative effects under Alternative A would include Cumulative Effects Common to all Alternatives. No additional cumulative effects to Special Status plants would occur under Alternative A.

Effects of Alternative B on Vascular Plants

- Alternative B would not contribute to the need to list any Special Status vascular plants or jeopardize species persistence of any Survey and Manage vascular plants.
- There would be no impacts from salvage or restoration activities and few benefits from habitat enhancement and fuels reduction projects.

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage is proposed. There would be no impacts to Special Status vascular plants from salvage operations.

Restoration

Direct and Indirect Effects

Surveys to detect Special Status vascular plants would be completed in all restoration areas prior to implementation of restoration projects. Any populations discovered would be protected as required. No direct impacts to Special Status plants would occur from restoration projects under this alternative.

Some risks from noxious weeds could result from the road projects, but the long-term benefits of improving and rehabilitating roads would outweigh short-term impacts. Surveying areas prior to road work and implementing project design features, described above under direct and indirect effects common to all alternatives, would minimize potential impacts of noxious weeds to Special Status vascular plant populations.

Thinning and planting in LSR forest habitat could indirectly benefit Special Status vascular plants associated with that habitat by accelerating development of late-successional characteristics. Oak woodland and meadow enhancement and pine restoration projects could benefit Special Status plants associated with those more open canopy habitats. There would be no impacts incurred from removal of cut trees using tractors.

A moderate amount of hazardous fuels reduction work is planned under Alternative B. Reducing fuel loads in all stand types would provide indirect beneficial effects to Special Status vascular plants by reducing the chance of high severity fire that could cause severe damage to soil and plants.

Other proposed restoration projects would have a neutral effect on Special Status vascular plants.

Cumulative Effects

Cumulative effects under Alternative B would include Cumulative Effects Common to all Alternatives. No additional cumulative effects would occur to Special Status plants under Alternative B.

Effects of Alternative C on Vascular Plants

- Alternative C would not contribute to the need to list any Special Status vascular plants or affect the species persistence of Survey and Manage vascular plants.
- There could be slight risks from salvage or restoration activities and moderate benefits from habitat enhancement and fuels reduction projects.

Salvage

Direct and Indirect Effects

Alternative C proposes a low amount of salvage and could potentially have a very slight negative effect to Special Status vascular plants. Surveys have been conducted in salvage units and Special Status vascular plants discovered would be protected. Some Special Status vascular plants may have remained dormant after the fire and were not detected during the surveys in 2003. There is a very slight chance that some plants could be impacted during salvage harvest. There would also be a slight risk of introducing or spreading noxious weeds during tractor logging, although project design features would minimize the risk of impacting Special Status vascular plants.

Restoration

Direct and Indirect Effects

Surveys would be conducted prior to all restoration activities and Special Status vascular plant sites discovered would be protected, as required, by avoiding or buffering plants. No direct effects to Special Status vascular plants would occur from restoration activities because sites and plants would be protected.

A moderate level of habitat enhancement is proposed under Alternative C. Reforestation and habitat enhancement projects in LSR forest stands, riparian reserves, oak woodlands and meadows, and pine stands would accelerate late-successional characteristics and promote habitat diversity across the watershed, which would provide beneficial effects to Special Status vascular plants.

There may be some risks of introducing or spreading noxious weeds from tractors used to remove trees in LSR forest habitat restoration, FMZs, and pine restoration projects, but the area impacted is small in relation to the total watershed and project design features should minimize those risks.

A moderate amount of hazardous fuels reduction work is planned under Alternative C. Reducing fuel loads in all stand types would provide indirect beneficial effects to Special Status vascular plants by reducing the chance of high severity fire that could cause severe damage to soil and plants.

Some risks from introducing or spreading noxious weeds could result from the road projects, but the long-term benefits of improving and rehabilitating roads would outweigh potential short-term impacts. Implementing project design features would minimize those potential impacts from noxious weeds.

Other proposed restoration projects would have a neutral effect to Special Status vascular plants.

Cumulative Effects

Cumulative effects under Alternative C would include Cumulative Effects Common to all Alternatives. While there is a potential for some short-term negative effects from implementing the proposed salvage and restoration projects in this alternative, the project design features would minimize the risks of negative effects. The positive effects resulting from the restoration projects would be long-term and would outweigh the potential negative effects. The proposed actions in Alternative C would not contribute additional negative cumulative effects to Special Status vascular plants and they would not result in a need to list

any Special Status vascular plants or jeopardize species persistence of Survey and Manage vascular plants.

Effects of Alternative D on Vascular Plants

- Alternative D would not contribute to the need to list any Special Status vascular plants or jeopardize species persistence Survey and Manage vascular plants.
- There could be low risks from salvage or restoration harvest activities and moderate benefits from habitat enhancement and fuels reduction projects.

Salvage

Direct and Indirect Effects

Under Alternative D, a moderate level of salvage is proposed. Although surveys have been conducted in salvage areas, there is a chance that some Special Status vascular plants did not recover the first year after the fire and might not have been discovered during surveys in 2003. There is a very slight chance that some plants could be directly impacted during salvage operations. There would also be a slight risk of introducing or spreading noxious weeds during tractor logging, although project design features would minimize the risk of impacting Special Status vascular plants.

Restoration

Direct and Indirect Effects

Surveys would be conducted prior to all restoration activities and sites discovered would be protected as required by avoiding or buffering plants. No direct effects to Special Status vascular plants would occur from restoration activities because sites and plants would be protected.

A moderate level of restoration is proposed under Alternative D. Reforestation and habitat enhancement projects in LSR forest stands, Riparian Reserves, oak woodlands and meadows, and pine stands would provide beneficial effects to Special Status vascular plants by accelerating late-successional characteristics and promoting habitat diversity across the watershed.

There may be some risk of introducing or spreading noxious weeds from tractors used to remove cut trees in LSR thin units, pine restoration projects, or FMZs, but the area impacted would be small in relation to the total watershed and project design features should minimize those risks.

A moderate amount of hazardous fuels reduction work is planned under Alternative D. Reducing fuel loads in all stand types would provide indirect beneficial effects to Special Status vascular plants by reducing the chance of high severity fire that could cause severe damage to soil and plants.

Some risks of introducing or spreading noxious weeds could result from the road projects, but the long-term benefits of improving and rehabilitating roads would outweigh the short-term impacts. Implementing project design features would minimize potential indirect impacts to Special Status vascular plants from noxious weeds.

Other proposed restoration projects would have a neutral effect to Special Status vascular plants.

Cumulative Effects

Cumulative effects under Alternative D would include Cumulative Effects Common to all Alternatives. While there is a potential for some short-term negative effects from implementing the proposed salvage and restoration projects in this alternative, the project design features would minimize the risks of negative effects. The positive effects resulting from the restoration projects would be long-term and would outweigh the potential negative effects. The proposed actions in Alternative D would not contribute additional negative cumulative effects to Special Status vascular plants and they would not result in a need to list any Special Status vascular plants or affect the species persistence of Survey and Manage vascular plants.

Effects of Alternative E on Vascular Plants

- Alternative E would not contribute to the need to list any Special Status vascular plants or jeopardize species persistence of any Survey and Manage vascular plants.
- The risks of potentially impacting Special Status vascular plants during salvage or restoration harvest activities are moderate under this alternative.
- Habitat enhancement and fuels reduction projects would provide beneficial effects to Special Status vascular plants.

Salvage

Direct and Indirect Effects

Alternative E proposes a medium high level of salvage. Surveys for Special Status vascular plants have not been completed in all Alternative E salvage units. If Alternative E is chosen, surveys would be completed in all units before salvage occurred. All sites discovered would be protected as required. Some Special Status vascular plants may have remained dormant after the fire and were not detected during the surveys in 2003. There is a chance that some plants could be impacted during salvage operations. There would also be some risk of introducing or spreading noxious weeds during salvage operations, although project design features would minimize those risks.

Restoration

Direct and Indirect Effects

Surveys would be conducted prior to all restoration activities and sites discovered would be protected as required by avoiding or buffering plants. No direct adverse effects to Special Status vascular plants from restoration activities would occur under this alternative because sites and plants would be protected.

Alternative E proposes a high level of restoration. Habitat enhancement in LSR forest stands, Riparian Reserves, oak woodlands and meadows, and pine stands would provide beneficial effects to Special Status vascular plants by accelerating late-successional characteristics and promoting habitat diversity across the watershed.

Under Alternative E, approximately 422 acres of LSR forest habitat restoration, pine restoration areas, and FMZs would be impacted by tractors when removing cut trees. There would be some risk of introducing or spreading noxious weeds by tractors under this alternative, although project design features would reduce those risks.

A high level of fuels reduction would occur on a variety of habitats under this alternative. Reducing fuel loads in these stands would provide indirect beneficial effects to Special Status vascular plants by reducing the chance of high severity fires that could cause severe damage to soil and plants.

Alternative E proposes a high level of road restoration work. The risk of introducing or spreading noxious weeds during road projects would be moderate under this alternative, but the long-term benefits of improving and rehabilitating roads would outweigh the short-term impacts. Implementing project design features would reduce potential indirect impacts to Special Status vascular plants from noxious weeds.

Other proposed restoration projects would have a neutral effect to Special Status vascular plants.

Cumulative Effects

Cumulative effects under Alternative E would include Cumulative Effects Common to all Alternatives. There is a potential for some short-term negative effects from implementing the proposed salvage and restoration projects in this alternative, but project design features would minimize the risks of negative effects. The positive effects resulting from the restoration projects would be long-term and would likely outweigh potential negative effects. The proposed actions in Alternative E would not contribute additional negative cumulative effects to Special Status vascular plants and they would not result in a need to list any Special Status vascular plants or affect the species persistence of Survey and Manage vascular plants.

Effects of Alternative F on Vascular Plants

- Alternative F would not contribute to the need to list any Special Status vascular plants or jeopardize species persistence of any Survey and Manage vascular plants.
- Potential impacts from salvage and restoration activities would be very low, but few benefits would be provided by habitat enhancement and fuels reduction projects.

Salvage

Direct and Indirect Effects

Alternative F proposes a low level of salvage harvest and no road construction. Surveys for Special Status plants were conducted in salvage units in summer 2003, however some plants may have remained dormant after the fire and were not detected during the surveys. The chance that some plants could be impacted during salvage operations would be minimal. The risk of introducing or spreading noxious weeds during tractor logging is also very slight and project design features would minimize those risks.

Restoration

Direct and Indirect Effects

Alternative F proposes a low level of restoration. Reforestation and habitat enhancement in oak woodlands and meadows inside the fire would be implemented. This alternative would provide low potential benefits to Special Status vascular plants through habitat enhancement. However, it would not create risks of noxious weed introduction or spread because no ground-based equipment would be utilized to remove cut trees.

Under this alternative fuels reduction would occur only in oak woodlands within the fire perimeter, some FMZs, and in owl activity centers. Reducing fuel loads in these areas would provide indirect beneficial effects to Special Status vascular plants by reducing the chance of high severity fire that could cause severe damage to soil and plants. However, fuel loads would remain high in many other areas in the watershed.

Road work under this alternative focuses on improving or protecting fish habitat. There could be some risks from introduction or spread of noxious weeds as a result of the road projects, but the long-term benefits of improving and rehabilitating roads would outweigh the short-term potential impacts. Implementing project design features would minimize the potential risks that noxious weeds would impact Special Status vascular plant populations.

Other proposed restoration projects would have a neutral effect to Special Status vascular plants.

Cumulative Effects

Cumulative effects under Alternative F would include

Cumulative Effects Common to all Alternatives. The potential for negative effects from implementation of the proposed salvage and restoration projects in this alternative is very slight. Project design features would minimize those risks. The positive effects resulting from the restoration projects would be longer-term and would outweigh any potential negative effects. The proposed actions in Alternative F would not contribute additional negative cumulative effects to Special Status vascular plants. They would not result in a need to list any Special Status vascular plants or jeopardize species persistence of Survey and Manage vascular plants.

Effects of Alternative G (Preferred Alternative) on Vascular Plants

- Alternative G would not contribute to the need to list any Special Status vascular plants or affect the species persistence of Survey and Manage vascular plants.
- There could be some low risks from salvage or restoration activities and moderate benefits from habitat enhancement and fuels reduction projects.

Salvage

Direct and Indirect Effects

Alternative G proposes a moderate level of salvage harvest. Surveys for Special Status vascular plants were conducted in salvage units in 2003 and sites that were discovered would be protected as required. Some Special Status vascular plants may have remained dormant after the fire and were not detected during the surveys in 2003. There is a very slight chance that some plants could be impacted during salvage harvest. There would also be a slight risk of introducing or spreading noxious weeds during salvage operations, although project design features would minimize the risks of impacting Special Status vascular plants.

Restoration

Direct and Indirect Effects

Surveys would be conducted prior to all restoration activities and sites discovered would be protected as required by avoiding or buffering plants. No direct effects to Special Status vascular plants are anticipated from restoration activities because sites and plants would be protected.

A moderate level of restoration is proposed under Alternative G. Reforestation and habitat enhancement projects in LSR forest stands, riparian reserves, oak woodlands and meadows, and pine stands would provide indirect beneficial effects to Special Status vascular plants by accelerating development of late-successional characteristics and promoting habitat diversity across the watershed.

There may be some risk of introducing or spreading noxious weeds by tractors when removing trees in restoration projects, but the area impacted would be small in relation to the total watershed and project design features would reduce those risks.

A moderate amount of hazardous fuels reduction work is planned under Alternative B. Reducing fuel loads in all stand types would provide beneficial indirect effects to Special Status vascular plants by reducing the chance of high severity fire that could cause severe damage to soil and plants.

A moderate amount of road restoration is proposed under Alternative G. Some risks from noxious weeds could result from the road projects, but the long-term benefits of improving and rehabilitating roads would outweigh the short-term impacts. Implementing project design features would reduce potential indirect impacts to Special Status vascular plants from noxious weeds.

Other proposed restoration projects would have a neutral effect to Special Status vascular plants.

Cumulative Effects

Cumulative effects under Alternative G would include Cumulative Effects Common to all Alternatives. While there is a potential for some short-term negative effects from implementing the proposed salvage and restoration projects in this alternative, the project design features would minimize the risks of negative effects. The positive effects resulting from the restoration projects would be long-term and would outweigh the potential negative effects. The proposed actions in Alternative G would not contribute additional negative cumulative effects to Special Status vascular plants. They would not result in a need to list any Special Status vascular plants or jeopardize species persistence of Survey and Manage vascular plants.

3.8.3.2 Lichens and Bryophytes

- No alternative would contribute to a need to list any Special Status lichens or bryophytes or affect the species persistence of any Survey and Manage lichens or bryophytes.

Salvage activities would have a neutral effect on Special Status lichens and bryophytes. Restoration projects would have a neutral to beneficial effect on Special Status lichens and bryophytes because pre-project surveys would be conducted and sites protected as required. Habitat restoration projects would have long-term beneficial effects to Special Status lichens and bryophytes by promoting habitat diversity and development of late-successional characteristics in conifer stands.

Effects Common to All Alternatives

Salvage

Direct and Indirect Effects

Salvage would occur in *Pseudotsuga menziesii* or *Abies concolor* conifer stands that burned at high and moderate severity. Only fire-killed trees would be salvaged, except in very limited areas as needed to facilitate logging system needs. Those areas were surveyed for Special Status lichens and bryophytes in summer 2003. Surveys for lichens and bryophytes on 120 acres in the research salvage units were also completed. No Special Status or S&M species have been discovered in the salvage units or in areas where helicopter landings or temporary roads would be constructed.

No direct effects from salvage operations on Special Status or S&M lichens or bryophytes are expected. Salvage would not likely affect Special Status lichens and bryophytes because it is assumed if Special Status lichens or bryophytes existed before the fire in high and moderate burn severity areas on soil, rock, or trees, they did not survive. Whereas vascular plant below-ground parts may persist and recover after fire, lichens and bryophytes reside on the surface of trees, soil, and rocks and are vulnerable to mortality from fire and heat. Salvaging fire-killed trees would not impact epiphytic (growing on the surface of plants) Special Status lichens or bryophytes. Because lichens and bryophytes that occur on soil and rock are not expected to have survived high or moderate intensity fire, salvage logging would also not negatively impact Special Status lichens or bryophytes that may have occupied those substrates prior to the fire.

Data collected during pre-project surveys would provide an indirect beneficial effect to Special Status lichens and bryophytes by increasing knowledge about the ranges, distribution, and abundance of species in the Butte Falls Resource Area.

The benefits of coarse woody debris (CWD) to lichens and bryophytes have been acknowledged (USDA and USDI 1994b, B-7, 8). The NFP Standards and Guidelines suggest retaining snags and logs after disturbance to provide for future CWD, but recommended leave amounts have not been established.

Many lichens and bryophytes utilize trees for substrate, but do not exchange nutrients or water with them. However, some species only occupy downed logs of a certain decay level. Lichens and bryophytes that occupied live trees or downed logs would have burned during the Timbered Rock Fire. The purpose of leaving CWD and snags in the high and moderate burn severity areas would be to provide for future substrate as the area recovers and is recolonized from surrounding live trees by lichen and bryophyte propagules. If all snags and CWD were removed from the salvage area, they would not be available to provide benefits to lichens and bryophytes. Recovery and development of this late-successional characteristic would be delayed.

All alternatives would leave snags and coarse wood in the Timbered Rock Fire area, although in varying amounts. In addition to snags and CWD left in each salvage unit, between 100 percent (Alternatives A and B) and 81 percent (Alternative E) of fire-killed trees greater than or equal to 8 inches DBH on BLM-administered land would remain after harvest. One hundred percent of fire-killed trees under 8 inches DBH would also be left.

No existing data suggests what level of CWD would be sufficient to meet the requirements of lichens and bryophytes. It cannot be assumed that more is better. If high amounts of dead wood occur, the risk is greater that another wildfire burning through the area would burn at high severity and cause more damaging, long-term effects to soil, plants, and micro-organisms.

In the absence of specific CWD and snag guidelines for Special Status or Survey and Manage lichens and bryophytes, it is assumed that the models used in Alternatives B-G that were developed to determine the amounts needed for late-successional associated species would also provide adequate future substrate for lichens and bryophytes in the salvaged units.

Restoration

Direct and Indirect Effects

There would be no direct effects to Special Status lichens or bryophytes from any restoration projects because surveys would be conducted prior to implementation and any sites discovered would be protected. Past surveys have documented two Special Status bryophytes and one lichen in restoration projects areas. See Table L-4 in Appendix L for locations and protection measures. It is expected that additional sites would be found during pre-project surveys.

Data collected during pre-project surveys would provide an indirect beneficial effect for Special Status lichens and bryophytes by increasing knowledge about the ranges, distribution, and abundance of species in the Butte Falls Resource Area.

Habitat restoration projects, including thinning and planting in uplands and riparian areas, pine restoration, and oak woodland and meadow restoration, would benefit Special Status lichens and bryophytes by improving habitat and promoting habitat diversity within the watershed. Accelerating development of late-successional characteristics would benefit those species associated with that habitat (i.e., *Leptogium rivale*). Thinning dense young conifer stands, mixed hardwood-conifer woodlands, and oak woodlands and meadows would open up the understory, provide more light, and increase plant diversity that provides substrate for some lichens and bryophytes. Restoration projects that maintain

Table 3.8-4. Comparison by Alternative of Restoration Projects Affecting Special Status Lichens and Bryophytes

	Alternative						
	A	B	C	D	E	F	G
Acres of habitat enhancement	0	2,378	4,024	4,024	6,577	540	4,024
Acres of fuels reduction	0	4,223	5,869	5,869	8,422	1,340	5,869
Effects of alternative	Neutral to slight negative	Low beneficial	Low-moderate beneficial	Low-moderate beneficial	Moderate beneficial	Slight beneficial	Low-moderate beneficial

oak woodlands would benefit species associated with that habitat, such as *Sulcaria badia* and *Ramalina thrausta*.

Reducing fuels in all habitat types would indirectly benefit Special Status lichens and bryophytes by reducing the likelihood that future wildfires would burn at high severity and damage them.

Table 3.8-4 shows potential effects of restoration actions on lichens and bryophytes.

Other restoration projects would have neutral effects on Special Status lichens and bryophytes because surveys would be conducted prior to project implementation and sites would be protected as required.

Cumulative Effects Common to All Alternatives

Lichen and bryophyte species that occur in southwestern Oregon may be adapted to low severity fire with frequent return intervals. They may survive low intensity, frequent fires, but not moderate or high intensity fires. There was likely mortality of Special Status lichens and bryophytes in areas that burned at high and moderate severity in the Timbered Rock Fire, as well as in other 2002 fires in surrounding watersheds. Because lichens and bryophytes grow very slowly, recovery in the Timbered Rock Fire area will take many years and will depend on available source material from adjacent areas or residual green trees. The cumulative effect of all the 2002 fires in southwestern Oregon may have been a loss of populations of rare or uncommon species, including Special Status or S&M species.

Fire suppression activities during the Timbered Rock Fire may also have impacted Special Status lichens and bryophytes. During construction of dozer lines, handlines, and staging areas, epiphytic lichens and bryophytes could have been directly disturbed when trees were cut down. Species that occur on soil or rocks may have been damaged by equipment driving over them. However, given the limited area impacted by these activities, the likelihood that Special Status lichens or bryophytes were affected by this activity is very slight.

There has been a loss or alteration of all habitat types throughout the Elk Creek Watershed as a result of past management actions including logging, road building, conversion to agriculture, and development. These activities will continue in the future on industrial forest lands and private lands. Special Status lichens and bryophytes receive no protection on private lands. In addition to directly impacting Special Status lichens and bryophytes, potential effects of these actions include habitat fragmentation and loss of habitat diversity. Mature forests with structural complexity and species diversity have often been converted to single-age stands.

Fire exclusion over the last 100 years has also resulted in habitat alterations due to changes in fire regimes, ecosystem processes, and forest and woodland structure. Fire burns unequally over a landscape, creating structural complexity which encourages biodiversity of habitats and species (The National Academies 2000, 121). As fuels build up, the risk of high severity fires and subsequent damage to Special Status lichens and bryophytes increases. Some species may increase in extent as a result of fire exclusion and may benefit in the short-term, but be negatively impacted in the long-term if their habitat is altered to become less suitable or more vulnerable to high severity fires.

3.8.3.3 Fungi

No pre-project surveys would be conducted for fungi because no fungi are in categories for which pre-disturbance surveys are required. Three Special Status and S&M fungi sites have been documented within the Elk Creek Watershed on BLM-administered land. Both sites of *Cortinarius olympianus* (S&M Category B) and *Tremiscus helvelloides* (S&M Category B) are located outside the fire in areas where no projects are proposed. The *Plectania milleri* (Bureau Tracking) site is located within the fire perimeter, but not within a proposed project area. These sites would not be impacted. The site of the fourth fungi species documented in the Elk Creek Watershed, *Ramaria rupripermanens* (Category D), is located on USACE land and would not be affected by any actions proposed in this EIS. If additional S&M or Special Status fungi sites are discovered on

BLM-administered land before project implementation, these sites would be protected according to Management Recommendations for Survey and Manage Fungi (Castellano and O'Dell 1997).

Only S&M Category B, D, and F and Bureau Tracking fungi are included on the Medford BLM Special Status Plant list. These are species expected to be found within the District. Management policy for Category B fungi gives direction to "manage all known sites and reduce the inadvertent loss of undiscovered sites" (USDA and USDI 2001b, S&G-9). Reducing the inadvertent loss of undiscovered Category B fungi sites is accomplished through Strategic Surveys, which are currently being conducted at a regional level. Management directions for Category D fungi are to manage known sites to provide for a reasonable assurance of species persistence (USDA and USDI 2001b, S&G-11). Managing known sites is not required for Category F fungi because they are uncommon, not rare (USDA and USDI 2001, S&G-13). The inadvertent loss of Category D and F fungi are not considered likely to change the level of rarity of these species (USDA and USDI 2001b, S&G-9-14).

Pre-disturbance surveys are not required for S&M or Bureau Tracking fungi. Bureau Tracking species are not considered Special Status species for management purposes and no further analysis is required. The effects of management actions on S&M fungi were analyzed under the FSEIS For Amendment to the Survey & Manage, and other Mitigation Measures, Standards and Guidelines (USDA and USDI 2001b) and strategic surveys are being conducted that satisfy the requirements of avoiding the inadvertent loss of undiscovered Category B fungi. No further analysis of the effects on S&M or Bureau Tracking fungi of salvage and restoration projects proposed under this EIS will be discussed.

3.9 Noxious Weeds

- Most species of noxious weeds inhabit open areas.
- Healthy stands of mixed conifers provide a high degree of shade which helps keep noxious weeds in check.
- The lack of competing vegetation immediately following a fire favors noxious weed expansion.
- Regardless of type or level of activity or alternative selected, noxious weeds are likely to expand their territory within the Timbered Rock Fire area.
- Noxious weed management direction is provided in the *Integrated Weed Management Plan and Environmental Assessment*.

Noxious weeds are those plant species designated by Federal or state law as generally possessing one or more of the characteristics of being aggressive and difficult to manage, parasitic, a carrier or host of serious insects or disease, and a nonnative (new to or not native to the United States).

The authority for treating noxious weeds on Federal lands lies with several documents:

- Federal Land Policy and Management Act (FLPMA).
- Public Rangelands Improvement Act (PRIA).
- Carlson-Foley Act.
- Federal Noxious Weed Act of 1974, consistent with the Northwest Area Noxious Weed Control Record of Decision (ROD) for the Final Environmental Impact Statement (EIS) and Supplemental EIS (FSEIS) dated April 7, 1986 and May 5, 1987 respectively.

General direction in the management of noxious weeds is provided in the Medford District *Integrated Weed Management Plan and Environmental Assessment OR-110-98-14*. In general, the BLM is directed to implement an effective weed management program with the objectives of preventing the introduction and establishment of noxious weeds, containing and suppressing existing noxious weed infestations, and cooperating with local, state, and other Federal agencies in the management of noxious weeds.

3.9.1 Methodology

Noxious weed species and locations were inventoried in the Elk Creek Watershed between 1996 and 2000. The scope of the inventory was limited to roadsides or areas that could be seen from roads. Roads and trails are the primary vectors for noxious weeds. During the inventory period, no systematic inventories were conducted outside roads and trails. Since that time, limited surveys for Threatened and Endangered and Special Status species were completed in 2004.

3.9.2 Affected Environment

3.9.2.1 Pre-fire

Most species of noxious weeds inhabit open areas where sunlight and nutrients are abundant and competition is minimal. Closed canopy conditions keep noxious weed sites to a minimum. Openings in the conifer overstory created by road construction are the primary locations for most weeds found within the Elk Creek Watershed. Habitats favoring noxious weed expansion and/or colonization vary. Factors, such as shade, soil types, and the amount of disturbance, can either inhibit or aid in noxious weed establishment.

Table 3.9-1 illustrates the known species, number of sites, and approximate square feet noxious weeds occupied on BLM-administered lands within the watershed. Weed populations outside the fire area, but within the watershed, are relatively small at this time. Additional noxious weed

Table 3.9-1. Noxious Weeds on BLM lands within the Watershed (Pre-fire)

Weed Species	Number of Sites	Size of Site
Canada thistle	5	4,070 ft^2
Scotch Broom	3	1,520 ft^2
Skeletonweed	1	10 ft^2
Spanish Broom	2	150 ft^2
Yellow Starthistle	18	193,320 ft^2

sites may have established in this area since the original surveys were conducted.

3.9.2.2 Post-fire

Noxious weeds are extremely aggressive and capable of establishing almost anywhere. Once established, noxious weeds are problematic to control. The lack of competing vegetation immediately following a fire favors noxious weed expansion. As trees, brush, and grasses reestablish themselves, they may out-compete noxious weeds for sunlight, moisture, and/or nutrients.

Fire control efforts, restoration, and post-fire salvage activities on adjacent private lands could spread weed seeds and weed parts into the area from locations outside the fire. Conditions following the fire are optimal for weed invasion. It is well established that foot traffic (recreational hiking, fire fighting, hunting, etc.), vehicular traffic (logging, sightseeing, fire fighting, land management), wildlife migration (animal and bird), and weather conditions (wind, erosion, etc.) are capable of aiding noxious weed movement and establishment. Project design features (as outlined in Section 2.3.1.3 and EA#OR110-98-14) will decrease the likelihood of weed transport and prevent weeds from becoming established.

The canopy has been reduced and sunlight penetrates to the forest floor. Competition from other species has been eliminated. The extent of the spread will not be known until the first or second growing season. It takes at least one year for the seeds of noxious weeds to germinate and reveal their locations. These newly-established sites will be treated when found. The best strategy for controlling noxious weeds (in terms of time and money expended) is to treat them when small in area, and prior to annual seed production. Some species, such as Scotch broom, can be successfully treated any time of year, although percent of kill or control may vary.

Because most noxious weeds are shade-intolerant, they have not become more dominant in the watershed. Healthy stands of mixed conifers provide a high degree of shade and keep noxious weeds in check. The Timbered Rock Fire changed the environment within the fire area to one with more direct sunlight and less vegetative competition for moisture and nutrients. This environment favors the establishment and/or spread of noxious weeds.

Immediately following control of the fire, an influx of noxious weeds was anticipated, primarily from fire control efforts. As a result, the entire fire control line (dozer and hand lines) was surveyed and treated for noxious weeds.

3.9.3 Environmental Consequences

3.9.3.1 Effects of Alternative A (No Action) on Noxious Weeds

Direct and Indirect Effects

Under Alternative A, the continuation of the broader noxious weed management strategies developed on the Medford District would occur.

Levels of weed treatment within the analysis area would remain at current levels in the short-term. Depending on the intensity of vehicular traffic into and out of the Timbered Rock Fire area, as well as ground-disturbing activities, weed populations would either rise or fall. The susceptibility of a habitat to weed colonization is largely dependent upon habitat health, prior disturbance, or existing characteristics that favor weed establishment. Human-caused disturbances would be the largest influence on the expansion of noxious weeds.

Treatment of noxious weeds would continue to occur under the *Medford District Integrated Weed Management Plan* (EA# 110-98-14).

Cumulative Effects

Under the No Action Alternative, some ground-disturbing activities would continue, especially those associated with logging activities on industrial forest lands. Noxious weeds could continue to invade and expand their territory across the Timbered Rock Fire area due to operations on private lands. The use of aerially and ground-based applied herbicides for control of competing vegetation on private industrial lands could also kill portions of noxious weed populations.

Vegetated sites outside the fire perimeter would have a better chance of withstanding the invasion of noxious weeds because existing vegetation has an advantage in water demand, sunlight requirements, and soil nutrients. Restoration and timber salvage efforts without mitigation on intermingled private lands, however, would exacerbate noxious weed expansion. The extent of weed expansion would be directly related to and dependent on the implementation of mitigation measures applied to project design, regardless of land ownership. With increased

disturbance within and outside the area of analysis, opportunities for the spread of noxious weeds increase. As vehicle, equipment, and human activities increase, each has the potential to carry weed seeds and/or plant parts to new, uninfested sites. The degree of this cumulative effect depends on the number of times ingress and egress is made, the extent of any ground disturbance, and the extent of weed control efforts.

Weed colonization and establishment influenced by activities in adjacent watersheds would remain at current rates. This is based on the assumption that current levels of other activities remain static. Risks to the rate of noxious weed expansion under this alternative would depend on human activities and disturbances.

3.9.3.2 Effects Common to Alternatives B, C, D, E, F, and G (Preferred Alternative) on Noxious Weeds

Salvage

Direct and Indirect Effects

Direct and indirect effects of salvage logging and restoration projects would not vary much by alternative. Proposed PDFs would reduce the spread of noxious weeds. Treatment of new infestations would control the spread of noxious weeds. Effects attributed to proposed salvage and restoration projects would not be distinguishable from those caused by the fire.

Projects proposed in these alternatives could spread noxious weeds at a higher rate than the No Action Alternative, due to a higher level of ground-disturbing activities. Areas of ground disturbance would be at risk for weed invasion, particularly if located near existing infestations. Areas where vegetation has been removed by fire or by fire control efforts would be more vulnerable to noxious weed invasion than areas where native vegetation is still intact. The level of expansion would depend directly on mitigating measures (vehicle washing, weed treatment, etc.). Data does not indicate how fast weeds would spread in response to certain ground-disturbing activities.

Relatively few noxious weed sites were known to exist within the fire perimeter. It is unknown to what degree these noxious weeds would expand. Weed treatment would depend on weed expansion and establishment. Initially, efforts to control weeds when they are first discovered would be intense.

Treatment of noxious weeds would continue to occur under all alternatives under the *Medford District Integrated Weed Management Plan* (EA# 110-98-14).

Cumulative Effects

Areas where vegetation was removed by fire, or by fire control efforts, are more vulnerable to noxious weed invasion than areas where native vegetation is still intact. Noxious weed expansion due to fire suppression activities, along with the loss of native vegetation due to the fire, may be an irretrievable effect unless treated. This loss of resource could span several generations if treatment does not occur.

While existing infestations of certain weed species may continue to increase on Federal and adjacent private lands, implementation of mitigation measures and project design features proposed under each project would actually decrease the risk of weed spread. Washing vehicles and equipment prior to entry, or prior to moving from one unit to another, using only grass seed that has been tested and certified as being weed-free by a certified weed seed laboratory, using proper procedures for testing, and reporting any known sites as soon as they appear, are some of the best methods for curtailing the spread of noxious weeds. The use of aerial- and ground-based herbicides for control of competing vegetation on adjacent industrial forest lands may also kill a portion of the noxious weed populations.

Helicopter logging in areas infested with weeds would increase the rate of spread during times when noxious weeds are in full bloom, or when seed is ripe for dispersal. Down drafts from rotor blades could displace weed seeds and scatter them over a large area. This could expand a relatively small, isolated, easily controlled site into one requiring massive outlays of time, effort, and money, unless treated. Vegetated sites outside the fire perimeter have a better chance of withstanding the invasion of noxious weeds because existing vegetation has an advantage in obtaining water, sunlight, and soil nutrients.

Weed colonization and establishment influenced by activities in adjacent watersheds would rise proportionally with the amount of disturbance, if current levels of other activities remain static. The risk of noxious weed expansion under these alternatives would depend on human activities and disturbances, but is expected to be low due to LSR management strategies.

With increased disturbance within and outside the area of analysis, opportunities for the spread of noxious weeds would increase. As vehicle, equipment, and human activities increase, each has the potential to carry weed seeds and/or plant parts to new, uninfested sites. Implementation of projects such as road construction or obliteration, placement or improvement of instream structures, culvert placement or improvement, or logging facility construction would increase the risk of weed spread through moderate levels of soil and vegetation disturbance.

Knowledge and skills related to controlling noxious weeds is continually increasing. Weed management and suppression is becoming more aggressive, which would result in reduced weed populations.

3.10 Fire and Fuels

- Existing fuel loadings have been changed within the fire perimeter. The amount of change is directly related to burn severity.
- Timbered Rock Fire burned in a mosaic pattern of various intensities.
- Effects on fuel loadings and future fire behavior will be analyzed and contrasted.
- Fuel loads remain high in many unburned portions of the watershed.

3.10.1 Methodology

The pre-fire condition is taken primarily from the 1996 Elk Creek Watershed Analysis (WA) prepared jointly by the Bureau of Land Management (BLM) and the US Forest Service (USFS). Review of the WA showed the fuel models chosen and fire behavior predictions used in that document were accurate. The Timbered Rock Fire burned across mixed land ownership. Lands consist of industrial forest lands, lands administered by three Federal land management agencies, and small farms along the creek bottoms. The checkerboard ownership pattern and differing management objectives create a mixture of fuel types.

Fuel models used in the analysis were derived from *Aids to Determining Fuel Models for Estimating Fire Behavior* (Anderson 1982). Satellite data was used to determine vegetation types and seral stages. The vegetation types were then associated with a corresponding fuel model. Fire return intervals were estimated using a literature search and personal observations.

3.10.2 Affected Environment

3.10.2.1 Fire Behavior

Fire behavior and potential are influenced by three major factors: vegetation, topography, and climate.

Vegetation

Elk Creek is a transition zone between the interior valleys of the Klamath Province (lower elevations) and the Cascade Province (higher elevations). The Klamath Province portions fit Condition Class 3 (most altered fire regime) criteria while the Cascade Province portions are characterized as Condition Class 1 (least altered fire regime). Condition Class is a function of the degree of departure from historical fire regimes resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure. Condition classes range from 1 (least altered) to 3 (most altered).

Plant series determine the average fire return interval with the drier series having a shorter return interval. Plant species also influence fire behavior differently. During a plant's life cycle, the new, young plants serve as heat sinks (requires more heat to burn than it generates) and older vegetation serves as heat sources (generates more heat than needed to initiate combustion), thereby moderating fire behavior.

The lower elevation interior valley portions are characterized by the more flammable schlerophyll brush species, such as madrones, manzanitas, and the drier ceanothus species. These species tend to burn with high fire intensity. Conifers are likely to be the more fire-resistant species, such as ponderosa pine and Douglas-fir, rather than true fir and hemlock. Brush species also appear as larger patches on south slopes throughout the area.

On north slopes and at the highest elevations, the brush species shift to higher moisture regime plants, such as dogwood, vine maple, and hazel. Douglas-fir and white fir are the dominate conifer species. Minor series associated with the site are hemlock and Shasta red fir.

Topography

Topography plays a major role in fire behavior. Drainages within this watershed are very steep with narrow bottoms and steep sidewalls. This type of topography is conducive to large fires. Fires on steep slopes preheat the fuels above them. The fire creates burning material which can roll down slope and spread the fire below the crews working to control the fire. This creates extremely hazardous conditions for suppression crews.

The larger unroaded areas in the upper reaches of the watershed (primarily on National Forest lands) also provide fire suppression challenges. Increased response time for initial attack, rugged terrain which minimizes options for suppression methods, and lack of access points for safe holding operations, result in increased firefighter safety concerns. A lack of defensible fireline locations often results in an indirect attack of fires because of firefighter safety concerns. Indirect attack will often lead to increased fire costs and size. Existing heavy fuel loads on ridge tops, particularly in the unburned portion of the LSR, contribute to safety concerns and the complexity of suppression actions.

Climate

Climate and summer weather patterns are dominated by a Pacific high pressure system. The Pacific high moves from its southern, winter position and migrates into the northern Pacific during the summer months. This high pressure forces storms and associated moisture north of the watershed. Annual precipitation ranges from 35-60 inches. Precipitation is rare in summer months with the majority occurring from October to late May or early June. It is not unusual for periods of up to 90 days with no precipitation in the summer.

When precipitation does occur, it often accompanies thunderstorms. These storms are triggered when warm, tropical, moisture-laden air from the southern Pacific clashes with the northern cold, dry, Pacific flows. The amount of moisture associated with these events is often variable. These storms often pose ignition threats from the associated lightning. The threat comes from the high number of potential fire starts during any given event and their potential to exceed the capabilities of initial attack forces, such as occurred during the fire events of 1987 and 2002. Because of the location of this watershed, storms often strike to the south and west of the watershed first. This means protection agencies have committed available suppression resources prior to the storm event reaching the watershed, leaving a potential shortage of initial attack resources as was witnessed in the 1987 and 2002 fire events.

Temperatures range from an average high of 75 degrees in June to 85 degrees in August. It is not uncommon for daily high temperatures to reach from mid-90 to 100 plus degrees. The potential for large stand-replacement type fires exists during these extended periods of high temperature and low humidity. At the head of the watershed, burning conditions may be moderated by higher humidity and fog spilling across from the Umpqua Basin into the Rogue Basin. Storms moving in from the north often just spill over the top of the divide, raising humidity and lowering temperatures for short periods of time. As the colder air moves over the divide it cools the surrounding area. However, as the cold air rides over the top of the warmer air, it compresses the air mass. As this air mass moves into the valley, there is actually a small drop in humidity from the compression action of the air movement in addition to the cooling effect. As a result, fire behavior may not be moderated by cooler air as much as expected.

3.10.2.2 Fire History

The Elk Creek Watershed has had an active fire history. Charred stumps, logs, and snag remnants are evident from the lower elevations all the way to the Rogue-Umpqua Divide. These fires would typically burn with a low to moderate severity. Douglas-fir is the primary species in this watershed. For a description of fire return intervals and severity by plant series, see Table 3.10-1. Because of the longer time frames between fires, the hemlock series burns at the highest severity. Severity levels are based on uninterrupted or unaltered fire frequencies. These stands do not fall into the realm of natural frequencies because of human fire exclusion efforts. Interruption of the fire cycle has created an increasing potential for wildfires to burn with much greater severity today than in the past. This effect is more pronounced at the lower elevations.

Table 3.10-1. Fire Return Intervals by Plant Series

Series	Fire Return Interval	Severity
Douglas-fir	18-25 years	mixed
Ponderosa pine	15-20 years	moderate
White fir	35-40 years	moderate
Shasta red fir	40-50 years	moderate
Hemlock	75-100 years	high

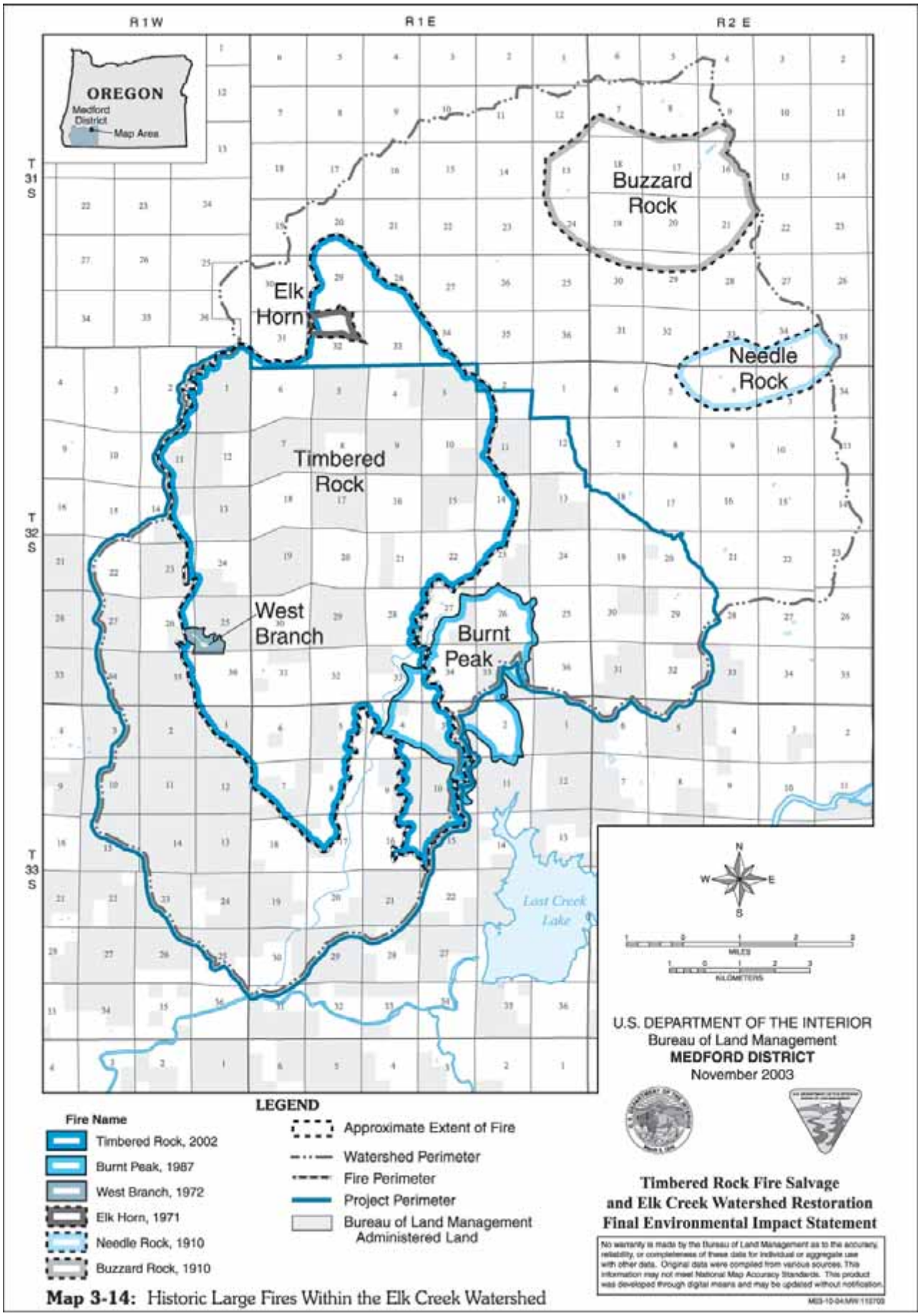
Fire starts were analyzed for a 25-year period. During that period the watershed averaged 8.5 fire starts per year. The fire starts that originated outside the watershed and had the potential to move into the watershed increased the average to 14.5 starts per year.

Large fire occurrence is not uncommon in this watershed; however the Timbered Rock Fire appears to be larger than the historical norm (see Table 3.10-2 and Map 3-14). Organized fire exclusion began about 1915.

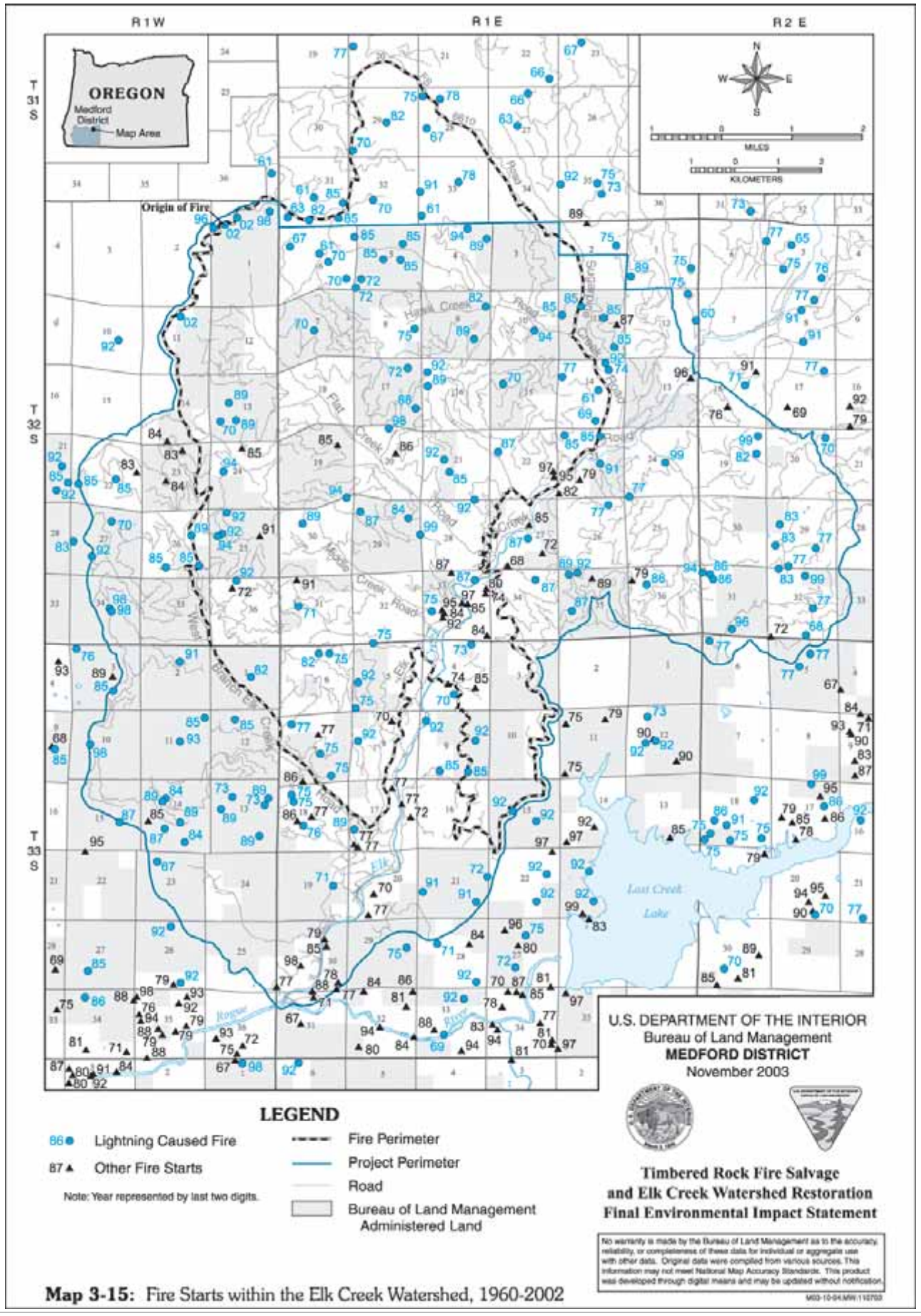
Table 3.10-2. Historic Large Fires in the Elk Creek Watershed

Fire Name	Year	Acres
Buzzard Rock	1910	10,000
Needle Rock	1910	5,000
Elk Horn	1971	300
West Branch	1972	300
Burnt Peak	1987	3,700
Timbered Rock	2002	27,000

Lightning has historically been a primary ignition source. Although it is assumed humans have also been an important ignition source, this type of fire cannot be quantified. Lightning occurrence maps for the last 10 years indicates that lightning has the potential to provide starts throughout the watershed at all elevations (see Map 3-15). Low to moderate intensity fires are a major influence on shaping fuel loads and fuel profiles. While large-scale fire events are more dramatic, the small-scale events shape vegetation and fuel profiles. Small, low-to-moderate severity fires provide the minor reductions in fuel profiles that reduce the potential for large scale catastrophic events. Fires, such as the Timbered Rock Fire, often burn in mosaic patterns, with various intensity levels and associated effects (see Map 3-1b).



Map 3-14: Historic Large Fires Within the Elk Creek Watershed



Map 3-15: Fire Starts within the Elk Creek Watershed, 1960-2002

An altered set of vegetative conditions exists today from those of the past. These changed conditions also result in a changed fire regime. In the past, fire was described as:

- Frequent.
- Low intensity and low severity.
- Primary fuel was the litter layer at ground level.
- Fires often spread over periods of weeks or months.

Fire behavior today has been altered by increased fuel buildup resulting primarily from fire exclusion. Current fires in timbered stands can be described as:

- Infrequent.
- Either insignificant or extreme during severe burning conditions.
- Primary fuel is dense vegetation often resulting in crown-type fires.
- Extended duration and not easily extinguished.

Fires in stands entered by logging operations without slash treatment can be described as:

- Extreme during severe burning conditions.
- Not easily extinguished.
- Primary fuel is slash.

As vegetation (biomass) increases on the site, the potential for stand-replacement type fires also increases. The multi-layered canopies now existing in some stands provide the greatest potential for these high intensity fires due to the abundance of ladder fuels. As the potential for crown fire increases, more radical fire behavior can be expected, such as increased spotting from prolific firebrand production. This makes control efforts difficult and expensive. These types of fires also present extreme safety hazards to fire suppression crews.

3.10.2.3 Pre-fire Fuel Models and Associated Fuel Models in Natural Stands

Fuel models are used to assess fire behavior. Different successional stages and vegetation types equate to different fuel models. Models allow for accurate, consistent, and repeatable predictions. This enables fire managers to predict fire behavior across a variety of locations. The models used in this document for fire behavior estimation use severe weather parameters to predict worst case behavior. These parameters are designed to display the greatest impact on suppression efforts. Table 3.10-3 shows fuel models and associated fire behavior found in the watershed prior to the Timbered Rock Fire. These fuel models also apply to the remainder of the LSR and would be applicable to modeling and projections.

Table 3.10-3. Pre-fire Fuel Models

Fuel Model	Primary Fire Carrier	Vegetation Type	Flame Length (feet)	Spread Rate (chains/hr)
1	Grass	Grass savannahs	4	78
4	Live and dead brush crowns, chapparal	Older ceanothus and manzanita brush fields	19	75
5	Litter cast by brush and forbs	Resprouting brush	4	18
6	Brush canopies; some chapparal and chemise brush types	Mid-seral brush fields	6	32
8	Compact timber litter layer	Closed canopied timber stands	1	1.6
10	Surface and ground fuels with potential for conifer torching	Timber stands with advanced reproduction pockets	4.8	7.9
11	Slash <3 inches	Light pre-commercial slash, manual brushing slash	3.5	6
12	Slash >3 inches	Heavy pre-commercial thinning stands, heavy logging slash	8	13

NOTE: 1 chain equals 66 feet.

3.10.2.4 Post-fire Fuel Models

Understanding the effects of the various burn severity levels is important in understanding both proposed actions and natural responses. Burn severity is partially a function of vegetation. A major shift in plant associations occurs with elevation change. The Timbered Rock Fire ranged from an elevation of 1,800-4,500'. At the higher elevations, a major shift in fuel models, fire regimes, and condition classes occurs. In addition to changing vegetation types, live fuel moistures were dramatically higher at the time of the fire at the higher elevations. This change plays a

Table 3.10-4. Burn Severity by Land Jurisdiction within the Timbered Rock Fire Perimeter (acres)

Burn Severity	BLM	Rogue River NF	Umpqua NF	USACE	State of Oregon	Private Industrial Forestlands	Other Private	Totals
High	987	2	-	5	-	1,744	60	2,798
Moderate	2,715	306	1	216	209	4,326	89	7,862
Low	4,250	738	34	213	21	2,991	244	8,491
V. Low/Unburned	3,822	1,601	49	177	4	2,079	217	7,949
Total	11,774	2,647	84	611	234	11,140	610	27,100

key role in understanding the differences in fire severity across ownership. Burned lands owned by the USFS did not approach the level of conifer mortality of the lower elevations.

On the Timbered Rock Fire, acres burned by severity class across land ownership and jurisdiction are shown on Table 3.10-4 and Figure 3.10-1.

The fire modified existing fuel models. The fire areas burned at high and moderate severity were reset to an early seral condition. These areas will return to the associated fuel models that were initially identified in the watershed analysis and will follow progression through time for vegetation recovery. Table 3.10-5 shows the changes in fuel models from pre- to post-fire.

In the areas of high and moderate severity, the remaining primary dead fuel loading is in the larger size classes such as the 1,000-hour time lag (3-6 inch diameter) and 10,000-hour time lag (6-9 inch diameter plus) size classes. Large woody fuels have little influence on spread and intensity of the initiating surface fire in current fire behavior models; however, they can contribute to development of large fires and high fire severity (Brown, Reinhardt, and Kramer 2003). These large fuels may also contribute to increased

Figure 3.10-1. Burn Severity in Timbered Rock

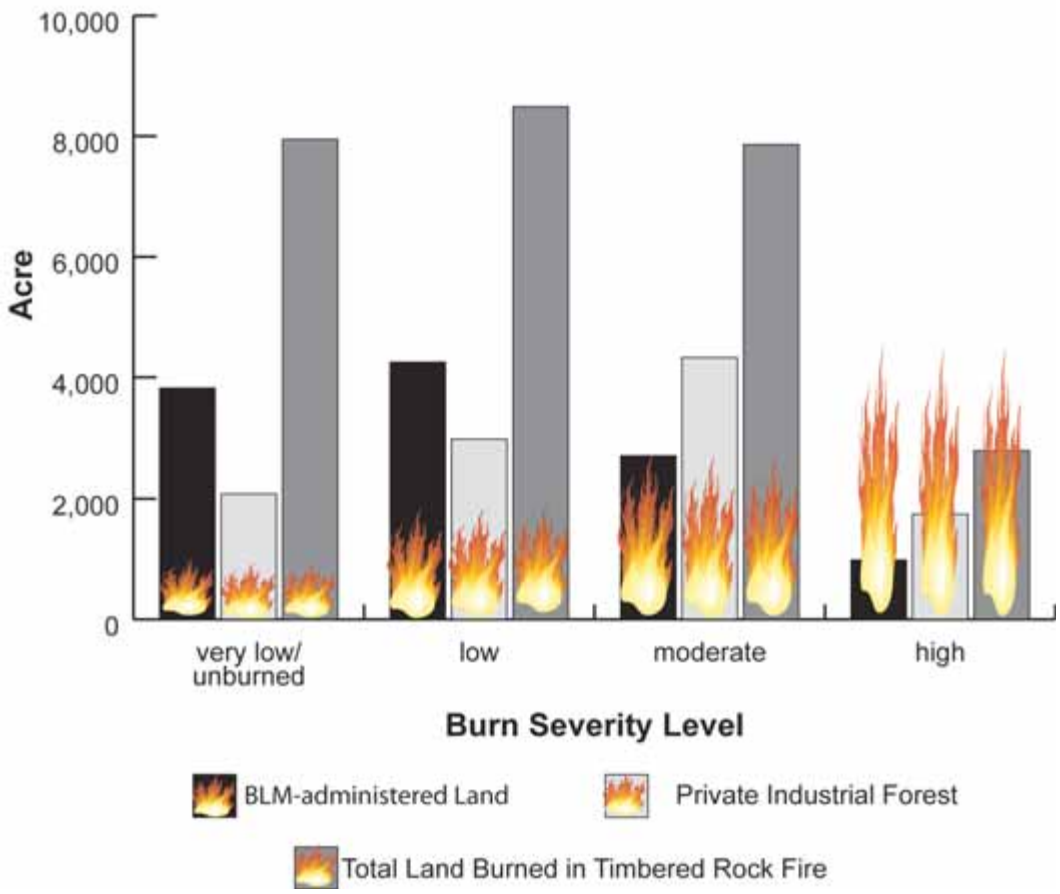


Table 3.10-5. Pre- and Post-fire Cross-over for Fuel Models

Pre-fire		Post-fire	
Fuel Models	Acres	Fuel Models	Acres
FM 1	1,248	**FM 1**	1,248
FM 4	989	**FM 5**	989
FM 5	36	**FM 5**	36
FM 6	2,055	**FM 5**	2,055
FM 8	4,087	**FM 8**	4,087
FM 9	64	**FM 5**	64
FM 10	11,717	**FM 8**	11,717

NOTE: **Green text** equals a reduction in future fire intensity. **Blue text** indicates no change.

resistance to control. Heavy fuels add to the time required to construct both hand and tractor fireline. These fuels contribute to increased difficulty for crews trying to hold firelines. Large fuels provide large, sustained pulses of heat into the soil which can impact long-term site productivity and water permeability (see Appendix M for soil heating information). In drought conditions, these fuels contribute to spotting potential (a primary method of fire propagation) by producing fire brands. The snags are both a receptor for and a producer of fire brands.

Because current pre-fire forests have elevated tree densities over that of historical forests, post-fire snag and log densities are now elevated. If the excessive snag and log densities are carried forward to the next forest and excess tree densities occur, the probability for fire events more severe than witnessed in Southwest Oregon in 2002 is expected. Natural processes are unlikely to remove the current dead tree material before the next fire event.

Although when or where the next fire will occur cannot be predicted with certainty, some conclusions can be drawn from past history. In 1987, the Burnt Peak Fire occurred. Sixteen years later the Timbered Rock Fire reburned portions of the same ground. In 1987, the Silver Fire occurred. Fifteen years later, the Craggie Fire burned portions of the Silver Fire. Sixteen years later, the Biscuit Fire reburned a large portion of the Silver Fire. In 1992, East Evans Fire burned. Twelve years later, two fires with potential occurred within the perimeter of the old fire requiring retardant to control them. In 1994, Hull Mountain burned. Nine years later, Neil Rock Fire burned through the old fire presenting control problems. These follow-up fires occurred within a 10- to 16-year time frame following the original fires. Based on this, the Timbered Rock Fire area will have sufficient fuels present for a reburn to occur within the next 10-20 years.

The areas burned at low to very low severity will have a short-term alteration of fuel loading expected to last 3-5 years as vegetation recovers to pre-fire conditions. In the areas of low and very low severity, an initial increased loading in the 1- and 10-hour fuels will occur as needles and small branches drop for the first year or two. The duff layer had little modification by the fire in these areas. Duff will still add to smoldering and potentially high soil temperatures. Resprouting brush will serve as a heat sink initially which provides a moderating effect on fire behavior. Some ladder fuels may remain from green understory vegetation. Scorched vegetation may contribute to ladder fuels for up to one year until scorched needles and leaves fall.

The Lower Timber Creek, Gobblers Knob, and Middle Creek owl activity centers were underburned by the Timbered Rock Fire. A major portion of the ladder fuels were removed. This creates a favorable site for future recolonization by the owls. Currently, theses sites are a low risk for a high intensity, high severity reburn. These sites are modeled as a fuel model 8. This reduced hazardous condition will deteriorate over time. In the next 20-30 years, ladder fuels will gradually rebuild to pre-fire levels. The Oliver Springs owl activity center is located in the unburned portion of the LSR. This site is at moderate to high risk of a stand-replacing fire. It would model as a fuel model 10. Ladder fuels and heavy ground fuel loadings are concerns.

One of the least recognized forms of vertical fire spread in the oak woodlands is the buildup of mosses and lichens on oak boles and crowns. In low severity fires within the oak woodlands, this component has been altered little and can remain a potential problem.

A reduction of the higher burn severity classes occurred in areas management ignited (burned out) to provide control lines over those sites consumed in the wildfire. Burnout operations are conducted under a specific set of weather conditions designed to provide a reduction in fuels while minimizing control and intensity issues. Burnouts are designed to remove ground and ladder fuels in front of an approaching fire while minimizing damage to the overstory.

3.10.3 Environmental Consequences

3.10.3.1 Fire and Fuels

Effects of Alternative A (No Action) on Fire and Fuels

Salvage

Direct and Indirect Effects

Under Alternative A, no salvage would occur.

Without salvage, fuel loadings would remain unchanged in the standing dead and large coarse wood. Over time, as standing snags begin to fall, there would be an increase

in large dead fuels on the ground (see Appendix M for information on soil heating based on fuel loadings). This would increase spotting receptors and sources. An increase in future burn severity would occur but it would not greatly influence spread rates.

Restoration

Direct and Indirect Effects

Spacing and species selection from reforestation would influence future fire behavior. Vegetation on federally managed lands will reestablish naturally. Brush species would be less flammable than planted conifer species for the first 15-20 years. After that time, the live-to-dead ratio in the brush would change and flammability would begin to increase over time. This alternative would not mitigate the concerns of firefighter safety, fire control, and access points.

Cumulative Effects

In the short-term (0-15 years), fuel loadings would slowly begin to rebuild. On industrial forest lands, intensive salvage has left few standing trees or large down logs to contribute to fuel loadings. Private industry is currently using and plans to use herbicides to control unwanted vegetation. This would reduce live fuel loads for 10-15 years. As conifer canopies close to 70 percent or greater, live fuels would quickly build. Any future thinning or logging on private lands would contribute to these fuel loads if slash treatment is not part of the project design. Thinning operations on private lands in the burn would raise fuel loadings after 15-30 years. The smaller the diameter of the slash created, the lower the hazard of high severity reburns. Smaller diameter material breaks down faster and burns with less duration. This alternative would not address firefighter safety and control issues. The dead and down material left from this fire would add difficulty to building control lines in future fires. Snags would also pose a serious safety hazard to crews working to control future fires.

Fuel models within the fire perimeter have changed as a result of fire altering the fuels. Fuel model 5 has the lowest fire intensity of the brush species. Fuel model 8 has the lowest fire intensity of the timber models. Fuel loadings in natural stands will continue to increase as undergrowth contributes to ladder fuels. This alternative would not reduce the threat to the wildland urban interface. Future fire severity in the unburned portion of the LSR would be equal to or greater than Timbered Rock, if the fire were to occur under similar burning conditions.

Effects of Alternative B on Fire and Fuels

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur. Without salvage, fuel loadings would remain unchanged in the standing dead and large coarse wood. Over time as standing snags begin to fall there would be an increase in large dead fuels on the ground (see Appendix M for information on soil heating based on fuel loadings). This would increase spotting receptors and sources. Future burn severity would increase but would not influence spread rates.

Restoration

Direct and Indirect Effects

Fuel management zones (FMZs) would be constructed on 1,300 acres. These zones would serve to provide control and anchor points for low to moderate intensity fires. These zones would meet the LSRA goal of using FMZs to divide the watershed into 5,000 to 7,000-acre blocks to reduce future large fire size. By changing understory vegetation, rates of spread within the FMZ may increase but this effect will be mitigated by reduced fire intensities. In FMZs constructed in timber stands, fuel models would change from fuel model 10 to fuel model 8 (see Appendix M for description of fuel models). This reduction in intensities would result in reduced risk and increased safety to firefighters. This action would give greater flexibility in suppression tactics and enhance the probability of success.

By replanting the FMZs within the fire perimeter to fire-resistant species such as pine, there would be a reduced risk of stand-replacement fires from reduction of fire susceptible species such as young fir. Future underburning in proposed FMZs and other areas, such as special habitat areas, would serve to maintain reduced fuel loading and benefits derived from the Timbered Rock Fire. These treatments would increase the resiliency of sites during future high intensity fire events by reducing fire severity.

The eagle nest project would reduce fuel loadings by thinning 50 acres and clearing around large trees. Decommissioning 35 miles of roads would slightly increase the probability of fire escaping initial attack. Pump chance reconstruction of eight sites would increase the probability of minimizing fire size and reducing fire costs by providing a reliable water source for initial attack. This action would potentially reduce refill times for fire engines during initial and extended attack. Pine release and thinning (excludes riparian thinning) on 1258 acres would reduce fuels and increase resiliency of treated stands to disturbance.

Cumulative Effects

Natural fuel loadings will build over time. On BLM-administered lands, hand cutting of brush for vegetation control would contribute to future fuel loadings. Slash would be monitored and treated as needed. As conifers reach canopy closure they present the same increasing risk as those on private industrial lands. On industrial forest lands, intensive salvage has left few standing trees or large down wood to contribute to fuel loadings. As conifer canopies

close, live fuels will quickly build. Any thinning or logging would contribute to these loads if slash treatment is not part of the project design. Thinning operations would be expected to raise fuel loadings after stands reach the age of 15-30 years. The smaller the diameter of the slash created, the lower the hazard of high severity reburns. Smaller diameter material breaks down faster and burns with less duration. New FMZs would tie into a network of fuels treatments currently under construction in the Lower Big Butte project area as well as the Flounce Around and Trail project areas. This network would provide a landscape approach to fuel hazard reduction in the upper Rogue basin and would meet the direction and intent of the National Fire Plan. Fuels would be slightly reduced over the No Action Alternative.

Effects of Alternatives C, D, and G (Preferred Alternative) on Fire and Fuels

Salvage

Direct and Indirect

Under Alternates C, D, and G, salvage of fire-killed trees would occur.

Salvage would reduce long-term fuel loadings (see Appendix M, Fuels).

Short-term changes in fuel loadings from salvage would occur. The majority of salvage material burned was in the moderate to high range. Most of the 1-hour time-lag and a portion of the 10-hour time-lag fuels were consumed in the fire, leaving few needles or twigs on the trees to contribute to fuel loads in these size classes. In the 1-hour size class, 0-.2 tons per acre would be available. In the 10-hour size class, 1.5 to 3 tons per acre would be expected after logging. These amounts are minimal. The primary increase would be in the 100-hour time-lag (1- to 3-inch size classes). Loadings in this size class would be expected to range from 5 to 7 tons per acre. This loading would approximate the natural loading of an unburned stand in the southern Cascades. The greater the total amount of biomass removed, the greater the reduction in fuel loads. In areas of patch salvage, there would still be standing snags. Over time, as standing snags begin to fall, an increase in large dead fuels on the ground would occur. This would increase spotting receptors and sources. Future burn severity would increase but it would not greatly influence spread rates. In the areas not salvaged, fuel loads would not be reduced.

Restoration

Direct and Indirect Effects

Fuel management zones would be constructed on 1,300 acres. These zones would serve to provide control and anchor points for low to moderate intensity fires. These zones would meet the LSR Assessment goal of using FMZs to divide the watershed into 5,000 to 7,000 acre blocks to reduce future large fire size. By changing understory vegetation, rates of spread within the FMZ may increase but this would be mitigated by reduced fire intensities. In FMZs constructed in timber stands, fuel models would change from fuel model 10 to fuel model 8 (see Appendix M, Fuels). This reduction in intensities would result in reduced risk and increased safety to firefighters. This action would give greater flexibility in suppression tactics and enhance the probability of success.

By replanting the FMZs within the fire perimeter to fire-resistant species such as pine, a reduced risk of stand-replacement fires by reduction of fire susceptible species, such as young fir, would occur. Future underburning in proposed FMZs and other proposed areas, such as special habitat areas, would serve to maintain the reduced fuel loading and benefits derived from Timbered Rock Fire. These treatments would increase the resiliency of sites during future high intensity fire events by reducing fire severity.

The eagle nest project would reduce fuel loadings by thinning 50 acres and clearing around large trees. Decommissioning of 35 miles of spur roads would moderately increase the probability of fire escaping initial attack. Pump chance reconstruction of eight sites would increase the probability of minimizing fire size and reducing fire costs. This action would potentially reduce refill times for fire engines during initial and extended attack. Pine release and thinning (excludes riparian thinning) on 2,121 acres would reduce fuels and increase the resiliency of treated stands to disturbance.

Cumulative Effects

Natural fuel loadings will rebuild over time. On BLM-administered lands, hand cutting of brush for vegetation control would contribute to future fuel loadings. Slash would be monitored and treated as needed. As conifers reach canopy closure they would present the same increasing risk across all ownerships. On industrial forest lands, intensive salvage has left few standing trees to contribute to fuel loadings. As conifer canopies close, live fuels will quickly build. Any thinning or logging would contribute to these loads if slash treatment is not part of the prescription. Thinning operations would raise fuel loadings after 15-30 years. The smaller the diameter of the slash created, the lower the hazard of high severity reburns. Smaller diameter material decomposes faster and burns with less duration.

New FMZs would tie into a network of fuels treatments currently under construction in the Lower Big Butte project area as well as the Flounce Around and Trail project areas. This network would provide a landscape approach to fuel hazard reduction in the upper Rogue basin and would meet the direction and intent of the National Fire Plan. Fuels would be moderately reduced over the No Action Alternative. Fuels treatments would help reduce safety and control issues.

Effects of Alternative E on Fire and Fuels

Salvage

Direct and Indirect Effects

Under Alternate E, salvage of fire-killed trees would occur.

Salvage would reduce long-term fuel loadings (see Appendix M, Fuels).

Short-term changes in fuel loadings from salvage would occur. The majority of salvage material burned was in the moderate to high range. Most of the 1-hour time-lag and a portion of the 10-hour time-lag fuels were consumed in the fire, leaving few needles or twigs on the trees to contribute to fuel loads in these size classes. In the 1-hour size class, 0-.2 tons per acre would be available. In the 10-hour size class, 1.5 to 3 tons per acre would be expected after logging. These amounts are minimal. The primary increase would be in the 100-hour time-lag (1- to 3-inch size classes). Loadings in this size class would be expected to range from 5 to 7 tons per acre. This loading would approximate the natural loading of an unburned stand in the southern Cascades. The greater the total amount of biomass removed, the greater the reduction in fuel loads. In areas of patch salvage, there would still be standing snags. Over time as standing snags begin to fall, an increase in large dead fuels on the ground would occur. This would increase spotting receptors and sources. Future burn severity would increase but it would not greatly influence spread rates. In the areas not salvaged, fuel loads would not be reduced.

Restoration

Direct and Indirect Effects

Fuel modification zones (FMZs) would be constructed on 1,300 acres. These zones would serve to provide control and anchor points for low to moderate intensity fires. These zones would meet the LSRA goal of using FMZs to divide watershed into 5,000 to 7,000 acre blocks to reduce future large fire size. By changing understory vegetation, rates of spread within the FMZ may increase but this effect would be mitigated by reduced fire intensities. In FMZs constructed in timber stands, fuel models would change from fuel model 10 to fuel model 8 (see Appendix M, Fuels). This reduction in intensities would result in reduced risk and increased safety to firefighters. This action would give greater flexibility in suppression tactics and enhance the probability of success.

By replanting the FMZs within the fire perimeter to fire resistant species such as pine, there would be a reduced risk of stand-replacement fires by reduction of fire susceptible species, such as young fir. Future underburning in proposed FMZs and other areas, such as special habitat areas, would serve to maintain the reduced fuel loading and benefits derived from the Timbered Rock Fire. These treatments would increase the resiliency of sites during future high intensity fire events by reducing fire severity.

The eagle nest project would reduce fuel loadings by thinning 50 acres and clearing around large trees. Decommissioning of 43 miles of spur roads would increase the probability of a fire escaping initial attack. Pump chance reconstruction on eight sites would minimize fire size and reduce fire costs. This action would potentially reduce refill times for fire engines during initial and extended attack. This alternative provides the greatest amount of thinning. Pine release and thinning would reduce crown closure and bulk density thereby reducing the risk of free running crown fire. Fuels would be slightly reduced over the No Action Alternative. Pine release and thinning (excludes riparian thinning) on 3,983 acres would greatly reduce fuels and increase resiliency of treated stands to disturbance.

Cumulative Effects

Natural fuel loadings will build over time. On BLM-administered lands, hand cutting of brush for vegetation control would contribute to future fuel loadings. Slash would be monitored and treated as needed. As conifers reach canopy closure they present the same increasing risk as those on industrial forest lands.

On industrial forest lands, intensive salvage has left few standing trees to contribute to fuel loadings. As conifer canopies close, live fuels will quickly build. Any thinning or logging would contribute to these loads if slash treatment is not part of the project design. Thinning operations could begin to raise fuel loadings after about 15-30 years. The smaller the diameter of the slash created, the lower the hazard of high intensity reburns. Smaller diameter material decomposes faster and burns with less duration. Overall, fuels would be reduced. New FMZs would only provide control and anchor points within the burned area. New FMZs would tie into a network of fuels treatments under construction in the Lower Big Butte project area as well as the Flounce Around and Trail project areas. This network would provide a landscape approach to fuel hazard reduction in the upper Rogue basin and would meet the direction and intent of the National Fire Plan. This alternative would provide the greatest measure of overall fuel hazard reduction.

Effects of Alternative F on Fires and Fuels

Salvage

Direct and Indirect Effects

Under Alternate F, salvage of fire-killed trees would occur.

This alternative would leave a large number of standing snags on site. This would do little to reduce fuel loadings over the entire fire area (see Appendix M, Fuels). Over time as standing snags begin to fall, an increase in large dead fuels on the ground would occur. This would increase spotting receptors and sources. Future burn severity would increase but it would not influence spread rates.

Restoration

Direct and Indirect Effects

In Alternative F, restoration activities would occur only within the fire perimeter. Fuel management zones would be constructed on 500 acres within the fire perimeter. FMZs in the fire area would address safety and control issues. FMZs would be built 200' within the LSR and 200' outside the LSR. Construction at the widths proposed in this alternative would minimally meet hazard reduction goals. Control and anchor points would be established. By changing understory vegetation, rates of spread within the FMZ may increase but this effect would be mitigated by reduced fire intensities. This reduction in intensities would result in reduced risk and increased safety to firefighters. This action would give greater flexibility in suppression tactics and enhance the probability of success. By restoring four pump chances, the probability of fire escaping initial attack would be somewhat reduced. This action would potentially reduce refill times for fire engines during initial and extended attack.

Decommissioning of 17 miles of roads would slightly increase the probability of fire escaping initial attack. Lack of thinning would increase probability of large fire occurrence. Planting at a 10'x10' spacing would reduce the flammability of the stand. Brush species would be less flammable than planted conifer species for the first 15-20 years. After that time, the live-to-dead ratio in the brush would change and flammability would begin to increase.

Cumulative Effects

Natural fuel loadings will build over time. On BLM-administered lands, hand cutting of brush for vegetation control would contribute to future fuel loadings. Slash would be monitored and treated as needed. As conifers reach canopy closure, they present the same increasing risk as those on private industrial lands.

On industrial forest lands, intensive salvage has left few standing trees to contribute to fuel loadings. As conifer canopies close, live fuels would quickly build. Any thinning or logging would contribute to these loads if slash treatment is not part of the project design. Thinning operations could be expected to begin to raise fuel loadings after 15-30 years. The smaller the diameter of the slash created, the lower the hazard of high intensity reburns. Smaller diameter material decomposes faster and burns with less duration. Overall, fuels would be reduced. New FMZs would tie into a network of fuels treatments under construction in the Lower Big Butte project area as well as the Flounce Around and Trail project areas. This network would provide a landscape approach to fuel hazard reduction in the upper Rogue basin and would meet the direction and intent of the National Fire Plan. This alternative provides fuel hazard reduction.

3.11 Air Quality

- Wildfires create large amounts of air pollutants.
- Wildfire events are usually of long duration.
- Wildfires have the potential to impact air quality over large areas.
- The pollutants of most concern are particulate matter in the 10 micron (PM10) and 2.5 micron (PM2.5) size classes.
- Smoke impacts from the Tiller, Apple, and Timbered Rock fires cannot be separated.

3.11.1 Methodology

The information on Particulate Matter (PM) appearing in this document is derived from a series of nephelometers located throughout Oregon. The nephelometer is an instrument that measures aerosol light scattering from particulate matter. Nepholometers are located in the key areas of concern: Grants Pass, Klamath Falls, Crater Lake, and Shady Cove (see Figure 3.11-1). These instruments are sited and set up according to Oregon Department of Environmental Quality (ODEQ) standards. Particulate matter is a by-product of the combustion process. Information and projected tonnages from wildfire and prescribed fire emissions used in this document were calculated. Emission factors vary by fuel model and treatment. Fuel models were generated using remote imagery. Emission factors are from studies conducted by Ottmar and Hardy in 1997.

3.11.2 Affected Environment

3.11.2.1 Smoke Emission from Fire

Southwest Oregon has a long history of air quality problems. The weather pattern is dominated by the Pacific high pressure. This pattern creates inversions during the summer and late winter months. The inversions often prompt air stagnation advisories. Air stagnation will trap pollutants at the lower elevations for extended periods of time. The topography of the Rogue Valley contributes to this problem. The valley is located in a bowl creating the need for a moderately intense storm to break the inversion and to mix air layers. Summer wind patterns are generally from the north or northwest.

During the spring and fall, winds tend to come from the south or southwest. During these periods the atmosphere is generally unstable which creates good atmospheric mixing and transport to move pollutants off-site. All prescribed burning is conducted in the spring and fall under the Oregon Smoke Management Plan. Dispersion, dilution and avoidance are techniques used for prescribed burning to minimize smoke impacts on local communities and direct smoke away from designated areas.

Crater Lake is designated under the Clean Air Act as a Class I area, where protection of visibility is of primary concern. This designation indicates the area has very clean air and is subject to the tightest restrictions on how much additional pollution can be added to the airshed. Crater Lake is protected under the State Implementation Plan which governs regional haze. Particulate matter, both PM10 and PM2.5, contributes to regional haze and reduced visibility. Three monitoring stations are located in the Cascade Mountains to monitor regional haze: Crater Lake National Park, Hoodoo Butte, and the Mount Hood area. Fire has not been shown to be the predominant long-term source of visibility impairment in any Class 1 area, although emissions from fire are an important episodic contributor to visibility aerosols (Sandberg 2002).

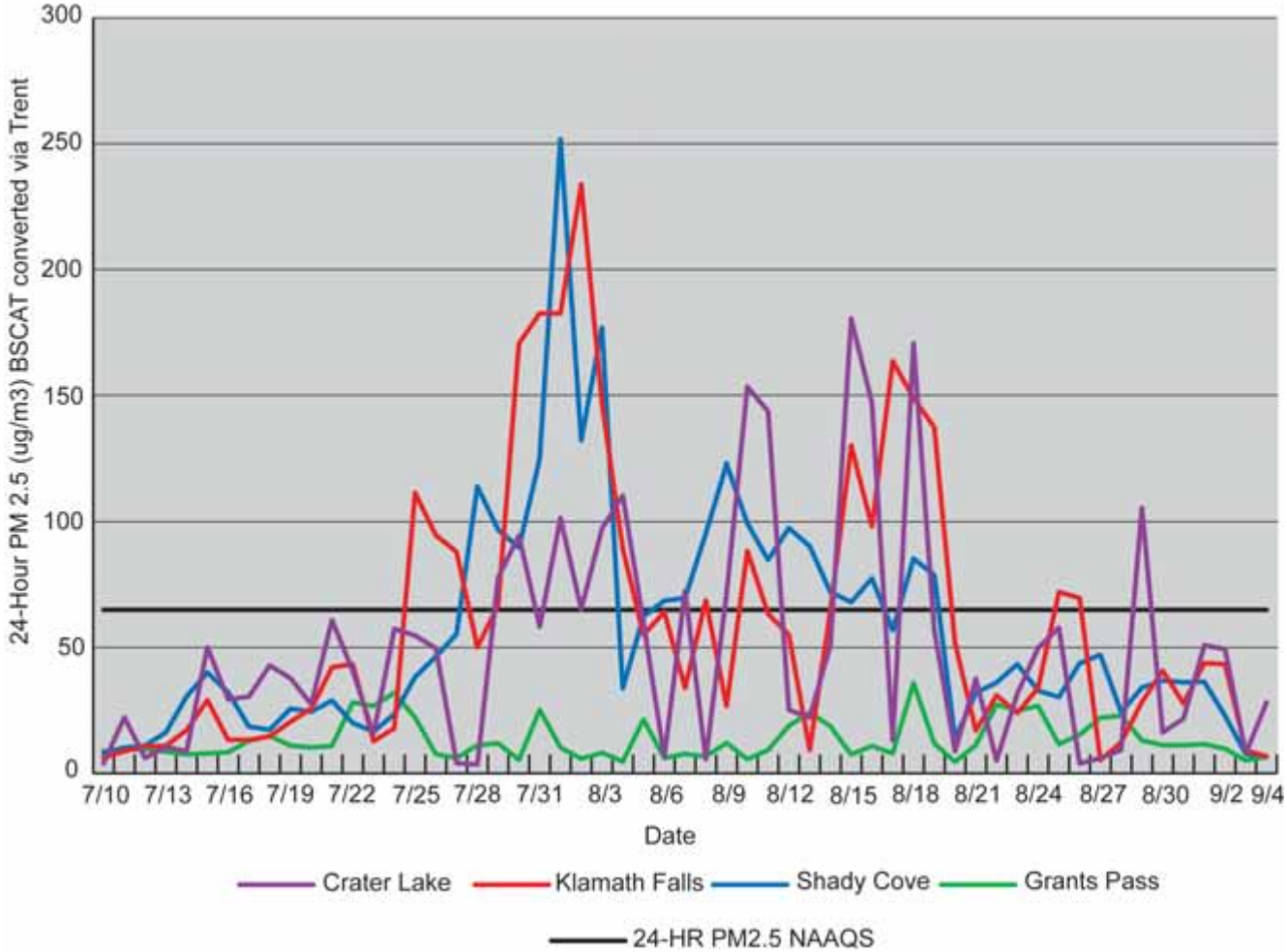
Particulate matter is also a major health concern. Grants Pass and Klamath Falls are designated by the Environmental Protection Agency (EPA) as "Non-Attainment Areas" for PM10. Medford was designated for PM10 nonattainment but has had no violations for the past three years. This designation is currently being reviewed for possible change to an "Air Quality Maintenance Area."

The EPA has set health standards for PM10 and PM2.5 for both 24-hour (daily) standards and annual standards. The PM2.5 standards are based on a 3-year average. The sampling began in 2000 and was completed in 2002. Once this data is compiled, those sites found to exceed standards will be designated as noncompliance sites. In addition to the designated sites, the fires impacted a large number of rural residences and smaller communities with no official designation. Tests indicate, on average, 90 percent of all smoke particles from wildland and prescribed fires are PM10 and 70 percent are PM2.5. The data on smoke is collected by ODEQ and then analyzed at a later date. The smoke from the Timbered Rock, Apple, and Tiller Complex fires had impacts on many communities throughout southwest Oregon (see Figure 3.11-1).

3.11.2.2 Composition of Smoke

Smoke from wildfire and smoke from prescribed fire are similar in composition. The emissions for wildfire are roughly double that of prescribed fire (Huff, et al. 1995). These differences in emissions are related to consumption. Consumption varies by fuel moistures at time of burning.

Figure 3.11-1. Air Quality Effects from 2002 SW Oregon Wildfires



Smoke is made up primarily of carbon dioxide, water vapor, carbon monoxide, particulate matter, hydrocarbons and other organics, nitrogen oxides, and trace minerals. The composition of smoke varies with fuel type. Wood and vegetation are composed of varying amounts of cellulose, lignins, tannins and other polyphenolics, oils, fats, resins, waxes, and starches which produce different compounds when burned.

In general, particulate matter is the major pollutant of health concern from wildfire smoke. Particulate is a general term for a mixture of solid particles and liquid droplets found in the air. Particulate from smoke tends to be very small (less than one micron in diameter) and, as a result, is more of a health concern than the coarser particles that typically make up road dust. Particulate matter from wood smoke has a size range near the wavelength of visible light (0.4-0.7 micrometers). This makes the particles excellent at scattering light and, therefore, excellent at reducing visibility.

Carbon monoxide (CO) is a colorless, odorless gas, produced from incomplete combustion. It is produced in the largest amounts during the smoldering stages of the fire. Carbon monoxide is potentially one of the most dangerous components of smoke. Concentrations drop rapidly as the proximity to the fire decreases and are usually of concern only to firefighters. Hazardous air pollutants such as acrolein, benzene, and formaldehyde are present in smoke, but in far less concentrations than particulates and carbon monoxide.

3.11.2.3 Health Effects of Smoke

The effects of smoke vary from irritation of the eyes and respiratory tract to more serious disorders, including asthma, bronchitis, reduced lung function and premature death. Studies have found fine particulate matter is linked (alone or with other pollutants) to a number of significant respiratory and cardiovascular-related effects, including increased mortality and aggravation of existing respiratory and cardiovascular disease. In addition, airborne particles are respiratory irritants, and laboratory studies (Therriault 2001) show that high concentrations of particulate matter cause persistent cough, phlegm, wheezing, and physical discomfort in breathing. Particulate matter can also alter the body's immune system and affect removal of foreign materials, such as pollen and bacteria, from the lungs.

The health threat from lower levels of CO is most serious for those who suffer from cardiovascular disease. At higher levels, carbon monoxide exposure can cause headaches, dizziness, visual impairment, reduced work capacity, and reduced manual dexterity, even in otherwise healthy individuals. At even higher levels (seldom associated solely with a wildfire), carbon monoxide can be deadly.

People exposed to toxic air pollutants at sufficient concentrations and durations may have an increased chance of cancer or other serious health problems. However, in general, it is believed that the long-term risk from toxic air pollutants from wildfire smoke is very low (Therriault 2001).

Some components of smoke, such as many polycyclic aromatic hydrocarbons (PAH), are carcinogenic. Probably the most carcinogenic is benzo-a-pyrene (BaP), which has been demonstrated to increase in toxicity when mixed with carbon particulates. Other components, such as the aldehydes, are acute irritants.

Three air toxins of most concern from wildfires are:

Acrolein - An aldehyde with a piercing, choking odor. Even at low levels, acrolein can severely irritate the eyes and upper respiratory tract. Symptoms include stinging and tearing eyes, nausea, and vomiting.

Formaldehyde - Low level exposure can cause irritation of the eyes, nose, and throat. Higher levels cause irritation to spread to the lower respiratory tract. Long-term exposure is associated with nasal and nasopharyngeal cancer.

Benzene - Benzene causes headaches, dizziness, nausea, and breathing difficulties, and is a very potent carcinogen. Benzene causes anemia, liver and kidney damage, and cancer.

Not everyone exposed to thick smoke will have health problems. Level, extent and duration of exposure; age; individual susceptibility; and other factors play a major role in determining whether or not someone will experience smoke-related health problems. An air quality advisory was issued for Medford for one day during the fire period from July 10 to September 9, 2002. This advisory was for increased ozone levels.

Ozone is a highly poisonous gas. Nitrogen oxides and volatile organic gasses combine to form ozone. EPA plans to begin including fire emissions in future ozone strategy modeling. Although not confirmed, there appears to be an indirect link between large smoke plumes and increased ozone levels. Klamath Falls Environmental Health issued 28 air quality advisories related to wildfire smoke from July 10, 2002 through September 9, 2002.

National Ambient Air Quality Standards (NAAQS) exceedences caused by natural events (i.e., wildfire) are not counted toward a nonattainment designation if a state can document it was a natural event. The state must prepare a Natural Events Action Plan (NEAP) to address human health concerns during future events. ODEQ has applied for an exceptional event waiver for the smoke intrusions in the Klamath Basin. If granted, this waiver would eliminate the need to prepare an NEAP for the 2002 wildfires.

3.11.3 Environmental Consequences

Effects of Alternative A (No Action) on Air Quality

Salvage

Direct and Indirect Effects

Under Alternative A, no salvage would occur.

Impacts to air quality relate directly to the amount of fuel (biomass) available for consumption in future fires. By leaving existing biomass on site, fuel loadings would increase over time.

Restoration

Direct and Indirect Effects

Only emergency fire rehabilitation projects would occur. Particulate matter is the pollutant of primary concern in smoke from both wildland and prescribed fires. The long-term risk from toxic air pollutants from forest fire smoke is very low. Other pollutants are found in smoke but in much lower concentrations (Therriault 2001). Carbon monoxide exposure has been studied extensively by the US Forest Service. These findings show concentrations can be a concern for fireline workers but concentrations dilute readily and drop rapidly as the smoke leaves the fire (Smoke Exposure at Prescribed Burns). Particulate matter stays suspended in the atmosphere for long periods of time and moves great distances off-site. Particles may also act as carriers of toxic substances. Health hazards are related directly to duration and intensity of smoke.

Under the No Action Alternative, emissions would be similar to those produced by the Timbered Rock Fire. This fire produced 11,975 tons of PM10 and 10,778 tons of PM2.5 for a total of 22,754 tons of particulate matter. These totals do not include emissions from other fires. If the unburned portion of the Late-Successional Reserve were to burn under similar circumstances, 28,933 tons of PM10 and 26,040 tons of PM2.5 for a total of 59,973 tons of particulate matter would be produced. These emissions would present health concerns to those individuals living downwind in the receptor areas. Under this alternative, no projects would be proposed to reduce fuels, and impacts to air quality from future wildfires would not be reduced.

Table 3.11-1 contrasts the prescribed fire emissions from project proposals to the wildire emissions that could occur if left untreated.

Cumulative Effects

When weather conditions are favorable for multiple large fires in adjacent watersheds, such as occurred in 1987 and 2002, this alternative would do nothing to lessen those impacts. Health hazards are a function of total fire emissions and this alternative would have no impact on future emissions.

Table 3.11-1. Predicted Emissions by Alternative from Wildfire and Prescribed Fire in the Unburned Portion of the Elk Creek Watershed

Alternative	Emissions	PM 10	PM 2.5
A	Wildfire	28,933 tons	26,040 tons
	Prescribed fire	N/A	N/A
B	Wildfire	1,196 tons	1,087 tons
	Prescribed fire	679 tons	543 tons
C, D, E, G	Wildfire	1,416 tons	1,416 tons
	Prescribed fire	804 tons	644 tons
F	Wildfire	375 tons	337.5 tons
	Prescribed fire	46.5 tons	27.5 tons

Effects of Alternative B on Air Quality

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur.

Impacts to air quality relate directly to the amount of fuel (biomass) available for consumption in future fires. Leaving existing biomass on-site would not reduce fuel loadings. By not salvaging, increased fuel loads would contribute to future wildfire emissions.

Restoration

Direct and Indirect Effects

Thinning and pine release of 1,258 acres would help reduce the threat of large-scale fires. Underburning in oak woodlands would help maintain reduced fuel loadings. Increasing conifer spacing and species selection would reduce flammability of future conifer stands. Construction of 1,300 acres of FMZs would help reduce future fire size. Owl activity underburns at four sites would maintain reduced fuel loadings. The eagle nest project would reduce fuel loadings by thinning 50 acres and clearing around large trees. Decommissioning 35 miles of spur roads would slightly increase the probability of fire escaping initial attack. Pump chance reconstruction on eight sites would increase the probability of minimizing fire size by providing a dependable water source.

Reduction of fuel loads would reduce the amount of material consumed, thereby lessening wildfire emissions. Reduction of fire size would lessen emissions.

Table 3.11-1 contrasts the prescribed fire emissions from

project proposals to the wildire emissions that could occur if left untreated.

The identified restoration projects with the exception of roads would reduce future emissions. The road decommissioning would have little impact on air quality. Fuels treatment areas would produce about half the emissions produced by wildfire. By following the Oregon Smoke Management Plan, fuels projects would use the dispersion, dilution, and avoidance strategy to minimize impacts to sensitive areas. By not salvaging, increased fuel loads would contribute to future wildfire emissions.

Cumulative Effects

When weather conditions are favorable for multiple large fires in adjacent watersheds, such as occurred in 1987 and 2002, a slight reduction in impacts to air quality would occur. Health hazards are a function of total fire emissions and this alternative would provide a slight reduction to future emissions.

Effects of Alternatives C, D, and G (Preferred Alternative) on Air Quality

Salvage

Direct and Indirect Effects

Under Alternates C, D, and G salvage of fire-killed trees would occur. Removal of biomass would reduce fuel loadings. Impacts to air quality relate directly to the amount of fuel (biomass) available for consumption in future fires following salvage operations. Salvage would reduce fuel loads thereby lessening emissions from future wildfires following salvage operations. The acreage differences would have only minor effects on emissions.

Restoration

Direct and Indirect Effects

Increased thinning would help reduce the threat of large scale fires. Thinning to less than 70 percent canopy closure would eliminate the threat of free running crown fires. Underburning in oak woodlands would maintain reduced fuel loadings. Increasing conifer spacing and species selection would reduce flammability of future conifer stands. Construction of 1,300 acres of FMZs would help reduce future fire size. Underburning four owl activity centers would maintain the reduced fuel loads produced by the Timbered Rock Fire.

The eagle nest project would reduce fuel loadings by thinning 50 acres and clearing around large trees. Decommissioning of 35 miles of road spurs would slightly increase probability of fire escaping initial attack. Pump chance reconstruction of eight sites would increase probability minimizing fire size by providing a reliable water source for initial attack. Reduction of fuel loads would reduce the amount of material consumed thereby lessening wildfire emissions. Reduction of fire size would lessen emissions.

Table 3.11-1 contrasts the prescribed fire emissions from project proposals to the wildire emissions that could occur if left untreated.

The identified restoration projects with the exception of roads would reduce future emissions. The road decommissioning would have little impact on air quality. Fuels treatment areas would produce about half the emissions produced by wildfire. By following the Oregon Smoke Management Plan fuels projects would use the dispersion, dilution, and avoidance strategy to minimize impacts to sensitive areas.

Cumulative Effects

When weather conditions are favorable for multiple large fires in adjacent watersheds, such as occurred in 1987 and 2002, there would be a moderate reduction in impacts to air quality from these alternatives. Health hazards are a function of total fire emissions. These alternatives would provide a moderate reduction to future emissions.

Effects of Alternative E on Air Quality

Salvage

Direct and Indirect Effects

Under Alternate E, salvage of fire-killed trees would occur.

Impacts to air quality relate directly to the amount of fuel (biomass) available for consumption in future fires. This alternative would remove the greatest amount of biomass. Maximizing removal of biomass would reduce fuel loadings.

Restoration

Direct and Indirect Effects

Increased thinning would help reduce threat of large scale fires. Thinning to less than 70 percent canopy closure would eliminate the threat of free running crown fire. Underburning in oak woodlands would maintain reduced fuel loadings. Increasing conifer spacing and species selection would reduce flammability of future conifer stands. Construction of 1,300 acres of FMZs would help reduce future fire size. Underburning four owl activity centers would maintain the reduced fuel loads produced by the Timbered Rock Fire.

The eagle nest project would reduce fuel loadings by thinning 50 acres and clearing around large trees. Decommissioning of 43 miles of road spurs would slightly increase the probability of fire escaping initial attack. Pump chance reconstruction of 8 sites would increase probability minimizing fire size by providing a reliable water source for initial attack. Reduction of fuel loads would reduce amount of material consumed thereby lessening wildfire emissions.

Reduction of fire size would lessen emissions.

Table 3.11-1 contrasts the prescribed fire emissions from project proposals to the wildire emissions that could occur if left untreated.

The identified restoration projects with the exception of roads would reduce future emissions. Road decommissioning would have little impact on air quality. Fuels treatment areas would produce about half the emissions produced by wildfire. By following the Oregon Smoke Management Plan fuels projects would use the dispersion, dilution, and avoidance strategy to minimize impacts to sensitive areas.

Cumulative Effects

When weather conditions are favorable for multiple large fires within the project area, such as occurred in 1987 and 2002, there would be a reduction in impacts to air quality in Alternative E. This alternative would produce the greatest reduction in fuel loadings. This alternative would have the greatest reduction of future air quality impacts. Health hazards are a function of total fire emissions. This alternative would provide the greatest reduction of future emissions.

Effects of Alternative F on Air Quality

Salvage

Direct and Indirect Effects

Under Alternate F, salvage of fire-killed trees would occur.

Impacts to air quality relate directly to the amount of fuel (biomass) available for consumption in future fires. Limited salvage will leave high fuel loads. High fuel loads would create high emissions in future wildfires.

Restoration

Direct and Indirect Effects

Limited restoration would occur outside of the fire perimeter.

Particulate matter is the pollutant of primary concern in smoke from both wildland and prescribed fires. It is believed long-term risk from toxic air pollutants from forest fire smoke is very low. Other pollutants are included in smoke but they are found in much lower concentrations (Therriault 2001). Carbon monoxide exposure has been studied extensively by the US Forest Service. These findings show that concentrations can be a concern for fireline workers but concentrations dilute readily and drop rapidly as the smoke leaves the fire (Smoke Exposure at Prescribed Burns). The concern with particulate matter is that it will stay suspended in the atmosphere for long periods of time and move great distances off site. Particles may also act as carriers of toxic substances.

Health hazards are related directly to duration and intensity of smoke. Emissions would be similar to those produced by the Timbered Rock Fire. This fire produced 11,975 tons of PM10 and 10,778 tons of PM2.5 for a total of 22,754 tons of particulate matter. These totals do not include any other fires. If the remainder of the Late-Successional Reserve were to burn under similar circumstances, 28,933 tons of PM10 and 26,040 tons of PM2.5 for a total of 59,973 tons of particulate matter would be produced. These emissions present health concerns to those individuals living down wind in the receptor areas.

Table 3.11-1 contrasts the prescribed fire emissions from project proposals to the wildire emissions that could occur if left untreated.

Cumulative Effects

When weather conditions are favorable for multiple large fires in adjacent watersheds, such as occurred in 1987 and 2002, there would be a minor reduction in effects to air quality from this alternative. Health hazards are a function of total fire emissions. This alternative would have a moderate impact on future emissions.

3.12 Wildlife

- Terrestrial wildlife habitat is predominantly Southwest Oregon Mixed Conifer-Hardwood forest in various stages of stand development with oak and dry Douglas-fir Forest and Woodlands, and Ceanothus-Manzanita shrublands.
- The habitat is highly fragmented.
- In the areas where the Timbered Rock Fire burned very hot, many acres of early seral habitat with an abundance of snags and coarse wood are present.
- Species associated with snags, coarse woody debris, and early seral habitats are expected to increase as a result of the fire.
- Late-successional habitat with low or very low underburning will return to normal pre-fire conditions within 2-5 years.
- The following species or groups are addressed in this section: northern spotted owl, northern goshawk, great gray owl, fisher, red tree vole, bat species, bald eagle, peregrine falcon, land birds, big game, and mollusks.

3.12.1 Methodology

The process for conducting biological evaluations and assessments includes review of existing records, field reconnaissance and surveys, and analysis of potential impacts. A review of potential habitat was conducted using maps, aerial photographs, Micro*Storms computer data, and stand exam records for the planning area.

Proposed projects on BLM-administered land would be

screened prior to implementation to determine what wildlife surveys are needed. A review would be conducted to determine if the proposed management action would occur in an area within the range and with potential habitat for the species of concern (T&E, Sensitive, S&M), and if it would negatively impact populations, if present.

Since completion of the Elk Creek Watershed Analysis in 1996 and the South Cascades Late-Successional Reserve Assessment in 1998, *Wildlife-Habitat Relationships in Oregon and Washington* (Johnson and O'Neil 2001) was published. This book compiles and synthesizes diverse information on 593 wildlife species and their relationships with terrestrial, marine, and freshwater habitat types of Oregon and Washington. This information was used to determine habitat types and analyze species expected to be present in the Elk Creek Watershed. This has resulted in some differences with the lists found in the LSRA and WA.

A bird survey route was completed in 1995, 1996, and 1997 in the Morine Creek drainage and along the ridge between Trail and Elk creeks. This route was repeated in 2003. The fire did not burn any of the area surveyed. The survey was used to compile a list of birds confirmed in the watershed (see Appendix N).

Oregon Department of Fish and Wildlife (ODFW) has a deer survey route along Elk Creek. Six great gray owl survey routes and six goshawk survey routes were run in the Elk Creek Watershed in 2003. Results are discussed in the species accounts below.

In 1985, BLM biologists began intensive surveys for spotted owls in the Elk Creek Watershed. From 1986 through 1996, the entire BLM portion of the watershed, which includes the burn area and LSR 224, was surveyed up to six times per year as part of a density study area (Miller Mountain Study) performed by the Oregon State University Cooperative Wildlife Research Unit (Robert Anthony, Frank Wagner). Boise and BLM biologists continued to monitor the known sites through the 2002 nesting season. The entire burn area was resurveyed in 2003.

Spotted owls were monitored using techniques described in *Methods and materials for locating and studying spotted owls* (Forsman 1983). Individual owls were color banded with plastic leg bands using techniques described in *A color band for spotted owls* (Forsman, et al. 1996, 507). Demographic performance factors such as adult turnover rate, adult shifting between sites, nesting attempts, and productivity of young were recorded.

Suitability of habitat for spotted owls was rated by BLM biologists in 1993-94 and entered into the Micro*Storms stand inventory database. Habitats 1 and 2 are suitable for owl nesting, roosting, and foraging. Habitats 3 and 4 are currently not suitable, and do not provide dispersal habitat. Habitats 5 and 6 are currently unsuitable, but provide enough cover to act as dispersal habitat for young owls. The watershed analysis data element (USDA and USDI 1996, Appendix page 27) provides a more detailed explanation of habitat types 1-6.

For this EIS, pre-fire spotted owl habitat typing was updated based on 2001 aerial photos and field verification. Some stands partial cut between 1975 and 1985 were too open during the initial rating to be considered as suitable. Since then, multiple tree canopy layers have grown up and closed in, so the habitat was more suitable for owls prior to the fire.

In 1998, 2,055 acres of USFS land transferred to BLM. These acres were added to the database. The revised habitat suitability ratings have been used for this draft EIS. Consequently, acreage figures differ from the Elk Creek Watershed Analysis and the South Cascades LSR Assessment. Medford District BLM has owl sites that produce young in marginal habitat. Due to various densities of stems and stand layers, there is an estimated 5 to 10 percent degree of variability or subjectivity in the accuracy of the owl habitat rating system on a section level analysis. On a 5th field watershed scale, the ratings should be within 5 percent.

Post-fire habitat analysis was based on fall 2002 aerial photographs and ground truthing.

The amount of pre- versus post-fire burned suitable owl habitat has been depicted for a ¼-mile and ½-mile radius around historic owl centers of activity. The ¼-mile radius (approximately 125 acres) corresponds to the area where the owl has historically nested. The ½-mile radius (approximately 500 acres) corresponds to the core use area that represents the mean 50 percent of their home range (Anthony, et al. 2002, 11). A study of habitat at 30 owl nest sites on the Willamette NF focused on the percentage of old-growth and mature forest within 260 hectare plots (620 acres), which is roughly a ½-mile radius (Ripple, et al. 1991, 317).

3.12.1.1 Assumptions

If no habitat is present in the planning area or the area is outside the range, then no further analysis is needed. If habitat is present, but no activities are planned for that habitat, then no further analysis is needed. If a threatened, sensitive, or special status species is known or suspected to be present and habitat is proposed to be disturbed, then the species would be analyzed (see Appendix N for the list of Special Status Species considered).

Computer-generated mapping polygons were assigned an owl habitat rating by BLM biologists. A sample of units were field verified where post-fire aerial photos were unclear as to underburn intensity. Mapping polygons often straddle

several habitat types, so post-burn acreage figures for habitat comparisons have a built-in accuracy/subjectivity of 5 to 10 percent.

Many acres of suitable spotted owl habitat underburned to various intensities, killing all vegetation to a 10-foot height. Removal of the ground layers of forage and cover are presumed to have impacted spotted owl prey species such as woodrats and voles. These prey species populations should rebound fairly rapidly, within two to five years, as the ground vegetation layers return.

New habitat categories 7 and 8 were created (as subsets of habitat 1 and 2) to quantify the underburned acreage where suitability for owls would be depressed in the short-term. Scattered large trees were killed, but the large, older seral stage, multi-layered tree canopy remains. This new subset should return to suitable owl habitat category 1 (nesting) and 2 (roosting/foraging) within 2 to 5 years.

To predict which historic owl sites will remain occupied following the burn, several factors were considered; the amounts of suitable habitat remaining within a ½-mile radius and how consistent were previous years' occupancy or productivity. The five sites vacant prior to the fire would remain unoccupied.

3.12.2 Affected Environment

Within the entire watershed, the majority of the uplands in the watershed are dominated by Southwest Oregon Mixed Conifer-Hardwood Forest in various stages of stand development (Johnson and O'Neil 2001, 28-30). Other habitat types in the watershed are Westside Oak and Dry Douglas-fir Forest and Woodlands, Ceanothus-Manzanita Shrublands, and Westside Riparian-Wetlands. These are minor parts of the watershed. Wildlife species associated with them were included with Southwest Oregon Mixed Conifer-Hardwood Forest list.

Special status species in the project area include several classifications:

- Federally Threatened or Endangered Species: species listed under the Endangered Species Act.
- Survey and Manage Species: species identified in the Northwest Forest Plan and the Medford District Resource Management Plan as needing special consideration due to their association with late-successional habitat.
- Bureau Sensitive Species: species the Bureau of Land Management considers to be of concern and which may have the potential in the future to become federally listed.
- Species identified by the State of Oregon as warranting special attention, either through listing under the Oregon Endangered Species Act or identification as an Oregon Special Status Species.
- Neotropical Migratory Birds of Conservation Concern identified by USFWS.

Two federally threatened, two Survey and Manage, and ten Bureau Sensitive species are known or suspected to be in the project area. The presence of two mollusk species is unknown.

In the high burn severity areas, large tracts of dead trees, both standing (snags) and on the ground (coarse wood), were created. High and moderate severity burns removed hiding cover and nesting substrate. This may recover quickly in some of the stands because of vigorous shrub sprouting, but may take much longer in areas where high severity fire destroyed root systems and seed sources.

Other areas within the fire perimeter had low severity underburn. Sometimes the result was large conifer overstory with pockets of severely burned timber within the stand. Other stands were lightly underburned, leaving an intact overstory of green conifers. In some areas, the underburn was light and created a mosaic of brush while in others, the understory brush and small trees were consumed, removing most of the undergrowth.

3.12.2.1 Species Associated with Late-Successional Habitat

Northern Spotted Owl (Federally Threatened)

Pre-fire

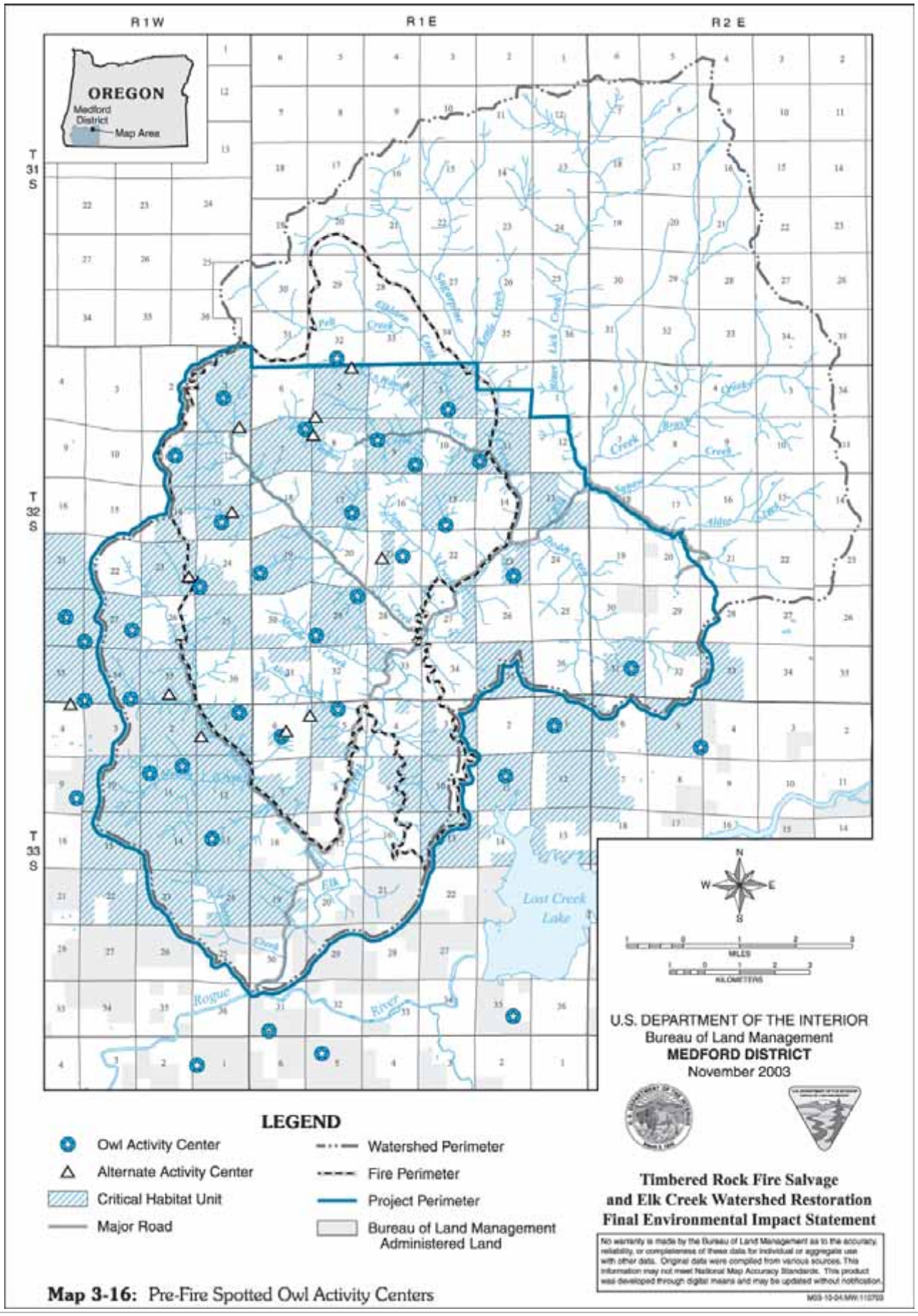
The Northern Spotted Owl (*Strix occidentalis caurina*) was federally listed as a Threatened Species in 1990. The species was Oregon State listed as Threatened in 1975 (see Appendix N, Wildlife, for a detailed account of monitoring efforts in Elk Creek and the management status of owls, as well as additional background on owl life history and habitat use).

Within the BLM portion of the burn, there were 19 spotted owl activity centers (see Map 3-16):

- Twelve owl activity centers that had attempted nesting in at least one of the past three years.
- One activity center that straddles USFS and BLM (Hawk Creek site).
- An additional five historic inactive centers where owls have not been detected in the past five years.
- One inactive historic center on private (East Jones Creek).

Outside the burn, but within the Elk Creek Watershed (LSR 224) there were:

- An additional five active activity centers on BLM west of the burn.
- Two inactive historic owl centers sites on BLM.



Map 3-16: Pre-Fire Spotted Owl Activity Centers

- Five historic sites not on BLM on the east side of the watershed.

These sites and their most recent 5-year monitoring history are listed in Appendix N. These sites will be addressed in Section 3.12.3 - Environmental Consequences. Several additional owl centers are located on USFS land at the north end of the watershed but outside LSR 224. Two of those sites were underburned.

The BLM sites had been included in the Miller Mountain Demography Study (Oregon State University Cooperative Wildlife Research Unit), which links spotted owl data with vegetative characteristics (Anthony and Wagner 1998). Field results through 1993 were summarized in *Demography of northern spotted owls in the Southern Cascades and Siskiyou Mountains, Oregon* (Wagner, et al. 1996). These results were combined with other similar studies from California, Oregon, and Washington in a range-wide meta-analysis of owl status and trends that updated results through the 1998 season (Franklin, et al. 1999).

A demographic study that included the Elk Creek Watershed (Anthony, et al. 2002, 47) found that apparent survival of spotted owls was best explained by the proportion of old forest habitat within a 730 meter radius (0.4 miles) of the activity center.

The amount of suitable, nonsuitable, and dispersal owl habitat within the Timbered Rock Fire area and the Elk Creek Watershed (LSR 224) are displayed in Figures 3.12-1 and 3.12-2. Pre-fire, there were approximately 10,510 acres of suitable habitat (Habitat 1 and 2) on BLM-administered land (USDA and USDI 1996, Appendix L, 2).

Figure 3.12-1. Pre- and Post-fire Owl Habitat within the Timbered Rock Fire Perimeter

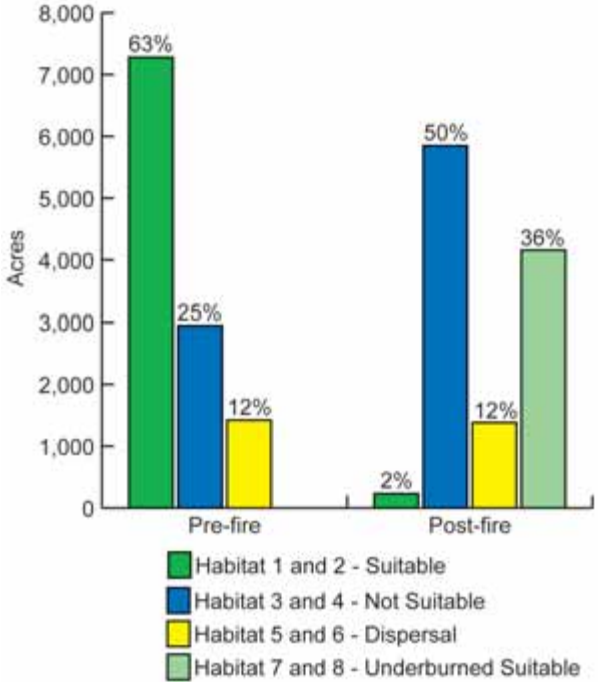
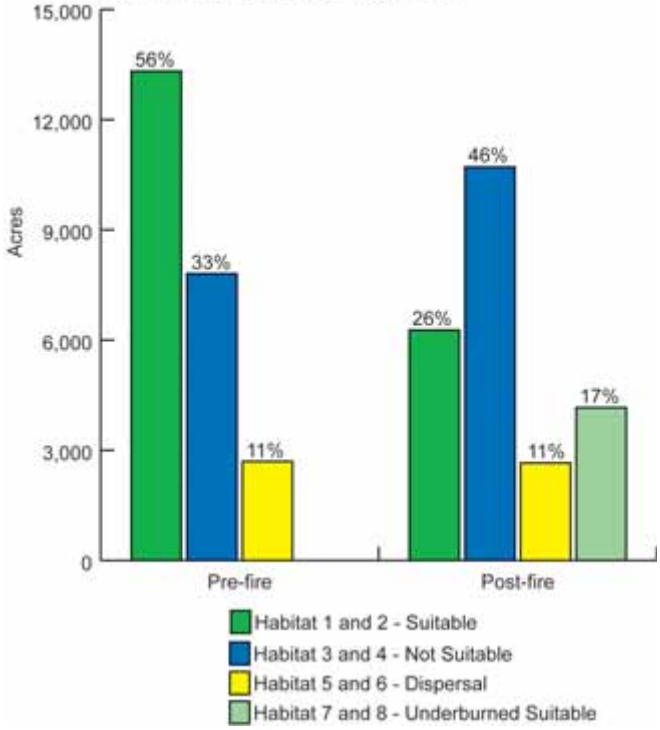


Figure 3.12-2. Pre- and Post-fire Owl Habitat within the Elk Creek Watershed



The entire burn area and all but the eastern corner of the watershed were designated as spotted owl Critical Habitat Unit OR-34 in 1992. The Northwest Forest Plan Appendix page A-3 references the role of Critical Habitat. The large LSRs provide the primary constituent elements of Critical Habitat (USFWS 2001c, 6).

The NFP provides for designation of 100-acre owl activity centers in Matrix lands for owl sites identified prior to January 1, 1994. Such activity centers are not identified for owl sites within the large LSRs, because the entire LSR is to be maintained on an older seral trajectory. Pre-fire, 55 percent of LSR 224 was in older seral (USDA and USDI 1998, 24). Pre-fire, 49 percent was in nesting, roosting, foraging (USDA and USDI 1998, 24). An owl pair may use several different nest trees over the years, but the pair usually continues to spend the majority of their nesting and roosting time in a 125-acre activity center.

Post-fire

Due to the large acreage burned in the Timbered Rock Fire, approximately 2,233 acres of BLM-administered land within the fire perimeter changed seral stages from mid- or late seral to early seral. The fire decreased the total amount of habitat available to wildlife that depend on late-successional habitat and increased habitat available to species which use early seral vegetation. The fire also increased fragmentation within the watershed.

There is a range of variability in how severely the habitat was degraded for owl activity centers. For example, the

activity center and surrounding ½-mile radius of the Shell Rock site was totally burned, with no green trees remaining. In the Timbered Rock activity center, two-thirds of the timber was killed, but considerable green patches of timber remain within one-half mile. Scattered patches of timber were killed in and adjacent to the activity center of the remaining 17 owl sites.

All the activity centers were underburned, where almost all vegetation to a 10-foot height was killed. New habitat typing designations 7 (nesting) and 8 (roosting and foraging) were created to depict these underburned areas where vegetation and owl prey species have been degraded for a period of 2 to 5 years. Most Medford District owl pairs nest on an average of every other year.

With a depressed prey population, the probability of successful owl nesting is decreased. An average of 4.4 young was observed the past 5 years from the 13 active sites within the burn with a similar annual monitoring effort (see Appendix N). The nesting status of several sites each year was undetermined, so the productivity estimate is probably slightly low. Owl productivity can have extreme swings annually, thought to be related to spring weather conditions (Anthony, et al. 2002, 44). For example, the following numbers of young were observed at Medford District owl sites from a similar annual monitoring effort: 173 in 1992, 27 in 1993, 219 in 1994, 36 in 1995, and 128 in 1996. This "odd-even" fluctuation has tempered in recent years, although the District-wide survey effort has not been as thorough. In summary, it is misleading to base productivity on a 1-year survey.

Due to the reduction in suitable habitat, the vulnerability to predation on spotted owls by northern goshawks and great horned owls has increased. Suitable habitat for competing barred owls has increased. Invading barred owls can displace resident spotted owls (Kelly 2001, 36).

A more open landscape (post-fire) is predicted to be more suitable to barred owls. Barred owls have not been detected within the fire area but there is a known pair to the east and to the west. Colonizing new pairs of barred owls would compete for prey with spotted owls.

The post-burn acreage in the various habitat categories are shown in Figures 3.12-1 and 3.12-2. Appendix N shows pre-burn and post-burn acreage within a ¼-mile radius (activity center scale) and a ½-mile radius (home range scale) of each owl site. The location of owl habitat is shown on Map 3-17. Of the 13 active sites within the BLM portion of the burn, habitat at 3 sites (Shell Rock, Timbered Rock, and Lower Timber Creek) was highly impacted and the remaining 11 sites were moderately impacted.

Intermingled private industrial forest lands were also depleted of foraging habitat. Pre-fire, roughly half the private lands were in stands from 30 to 80 years old that supported owl prey such as woodrats, mice, and voles. BLM did not rate this acreage as suitable owl habitat because there is no commitment to maintain those areas in a mature or older seral stage. However, those lands supplement owl foraging with less dense populations of prey species. Post-fire, private landowners are salvaging burned acreage (approximately 6,000 acres) and removing most of the standing snag and downed woody habitat. Salvage logging on private industrial forest land is projected to be completed by fall 2003.

The quality of the Critical Habitat (4,149 acres) was degraded for the short-term (2 to 5 years) by underburning. An additional 2,887 acres were burned severely enough to shift from suitable to unsuitable and will not become suitable for at least 60-80 years. BLM plantations 15-30 years old were consumed, setting their suitable habitat trajectory back to zero.

BLM and Boise biologists resurveyed the entire watershed in April through August 2003 to locate remaining resident owls (see Appendix N, Wildlife, Table N-3).

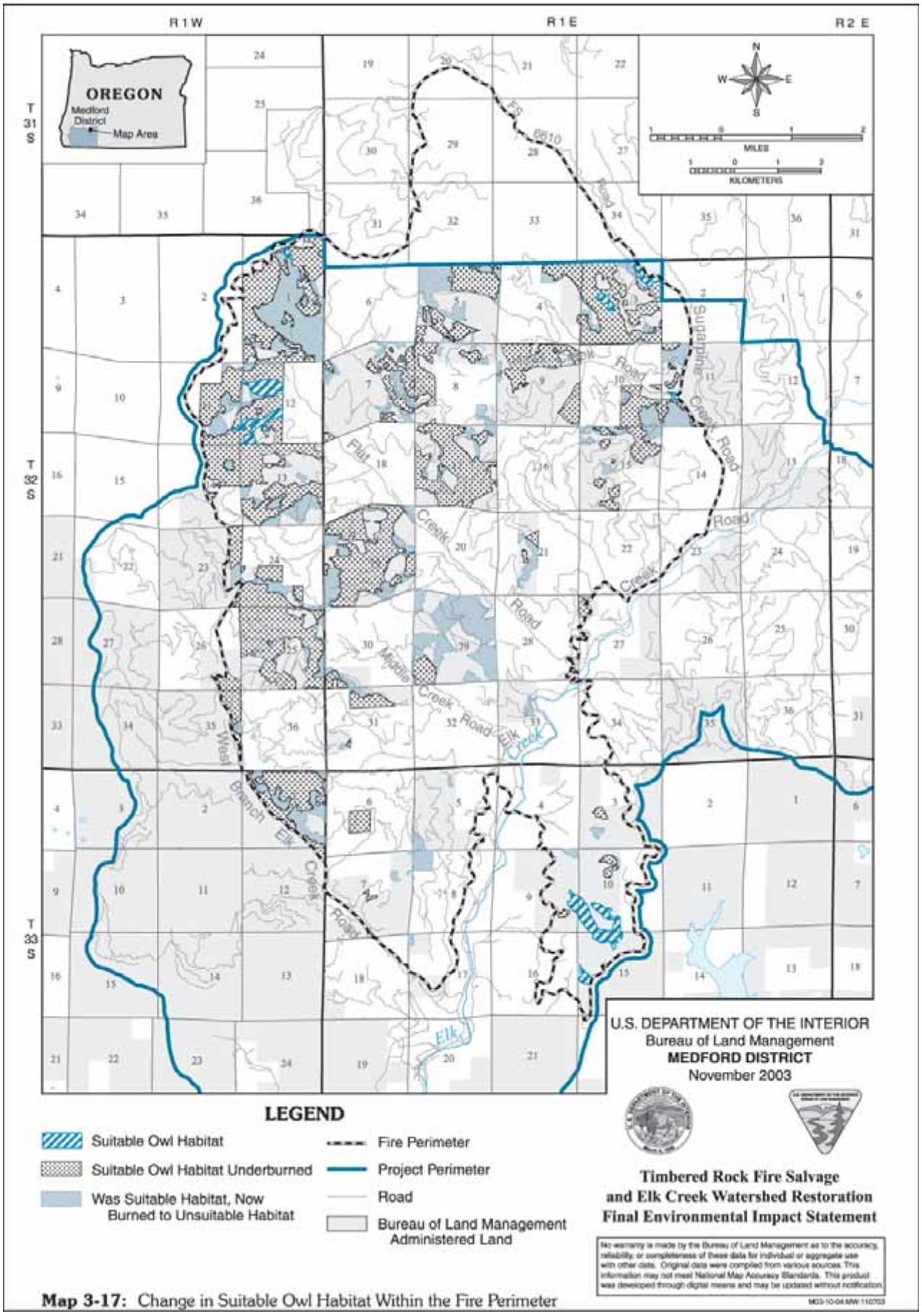
Four of the 13 previously active sites were predicted in the DEIS to be vacant post-burn, but only two owl sites (Shell Rock and Lower Timber Creek) were vacant in 2003. Only the male was detected at Timbered Rock, and his center-of-activity had shifted one-half mile south to a less intensely burned area.

In 2002, 23 adult owls had been detected at 12 active sites (a 13th was not checked), with the color band confirmed on 19 individuals. In 2003, 20 adult owls were detected. Two sites had single males; the other 7 sites contained pairs. The old color band was confirmed on 13 individuals, with 4 new birds (unbanded) confirmed. Three birds were not viewed to determine color band status. No owls from within the burn area were documented as shifting from one territory to another.

None of the five historically vacant sites within the burn area became active. Just outside the burn, the Louis Creek site became active with the first detection since 1993.

One "new" site (Hungry Elk) was detected in June just outside the burn area. Barred owls have occupied the adjacent historic Spot Creek spotted owl site since 2001, and the resident spotted owls have not been detected for two years. The new Hungry Elk pair was one mile north of the Spot Creek activity center, but neither adult was from the historic site.

Some adult owls probably perished in the fire. Others emigrated during the following months, but were not detected in opportunistic surveys of known sites on BLM-administered land in adjacent watersheds.



Map 3-17: Change in Suitable Owl Habitat Within the Fire Perimeter

With impacts to the vegetation, and thus to the prey base, and reduction in cover from owl predators resulting from the fire, and subsequent widespread salvage on private lands, it is predicted additional individual owls will disappear from the burn area by the 2004 nesting season. The Miller Mountain and Alco Creek pairs are likely to not persist, due to the small amount of suitable habitat within one-half mile.

Currently vacant sites have a very low probability of being reoccupied within 10 years. The Timbered Rock owl will probably continue to shift its activity center location until it finds a mate. The other active sites are expected to remain in their historic groves, rather than shifting location.

Within the burn area, three pairs nested. A dead young was found below the nest at Upper Timber Creek, one young successfully fledged at Alco Rock, and the fledging status was undetermined at Hawk Creek. Across the Medford District, there are swings in productivity from year to year, and 2003 was a down year for spotted owl productivity. Nesting success within the burn area is predicted to remain low for several years. Active sites just outside the burn are predicted to be more productive.

BLM, Boise, and OSU personnel will resurvey the watershed in 2004. In September 2003, OSU began a radiotracking project with owls in the burn area. The objective is to document habitat use of stands burned at various intensities. As of mid-October 2003, four adult spotted owls have been instrumented.

Owls are capable of returning to even a severely altered former nest grove in the year following the burn, and will sometimes nest if a suitable cavity or platform remains. Due to site tenacity, owls in northern California returned to four sites where the majority of the territory had burned (Bond, et al. 2002). Site tenacity refers to the bird's tendency to return to the old activity center.

"Because spotted owls exhibit high affinity and tenacity to home ranges and favored nest locations, they may continue to reside and nest in specific locations in spite of adjacent habitat alterations subsequent to original selection of the site. In other words, spotted owl pairs may select a particular nest site prior to habitat alteration and then continue using it even if conditions affecting their survival and reproductive potentials (or those of their young) have changed." (Swindle, et al. 1999, 1219).

BLM LSR 224 connects to the north with USFS LSR 222, where 2 additional owl activity centers plus half a shared owl site were lightly underburned. Within the BLM portion, 50 percent of the landscape remains in suitable or dispersal habitat.

Even with neighboring Federal timber sales, private salvage, or fires, ample dispersal habitat remains across the landscape to enable owl genetic interchange between the LSRs. The NFP established LSRs approximately 12 miles apart. The Elk Creek LSR links to LSR 223 (Galesville) 7 miles to the west and LSR 226 (Sky Lakes/Middle Fork) 12 miles to the east. Across western Oregon, median natal dispersal distances were 9 miles for juvenile males and 15 miles for juvenile females, with 8 percent of young owls dispersing over 30 miles (Forsman, et al. 2003, 2).

Spotted owls are mobile enough that dispersal to adjacent LSRs would not have been seriously inhibited by the wildfire or the subsequent salvaging on non-Federal lands.

Northern Goshawk (State Critical, Bureau Sensitive)

Pre-fire

The Northern Goshawk (*Accipiter gentilis*) is found in a variety of mature forest types, including both deciduous and conifer. Nesting habitat is mature forest with high canopy closure and an open understory. Suitable habitat is present in Elk Creek Watershed. Adult goshawks have been observed, but no nests were found during follow-up surveys in the stands where the goshawks were reported.

A petition to list the northern goshawk in the western United States as a threatened species was considered by USFWS in 1998 and the final conclusion was published that year (*Federal Register,* Vol. 63, No. 124, 35183-35184). They found no evidence to support the contention that the goshawk was in danger of extinction or that the species is likely to become endangered in the foreseeable future throughout all or a significant portion of its range.

No historical records of goshawk numbers in the Elk Creek Watershed exist. Incidental sighting reports indicate they were present in the watershed pre-fire, although likely in low numbers. No nests have been located. Past timber harvest actions on BLM and private lands removed large trees and created openings of early seral conifer, reducing suitability for goshawk, which nest in the large trees and forage in the understory.

Past fire exclusion may have reduced the suitability of some stands for goshawk by allowing the understory to develop. Two historic goshawk nests are known to be present in adjoining watersheds; Trail Creek Watershed and Lost Creek Watershed. Elk Creek is located between these two watersheds.

Post-fire

High and moderate burn severity occurred on 1,880 acres of late seral habitat and 353 acres of mid-seral habitat. These acres are no longer habitat for goshawk. The fire set these stands back to early seral vegetation.

Within the Elk Creek Watershed, approximately 9,247 acres of unburned late seral forest remains on BLM-administered land. Suitability of these acres varies between optimal and low, depending upon the understory density. Low severity burns in late-successional stands removed vegetation in the understory and improved the stands for goshawk. The prey in these areas may have been impacted by the light burns, but are expected to recover in the next one to five years.

Surveys conducted in 2003 did not find any goshawks.

Great Gray Owl (Survey and Manage)

Pre-fire

The Great Gray Owl (*Strix nebulosa*) forages in open areas such as meadows or clear-cuts, conifer forests, and oak woodlands. Nests are in tree cavities, large broken-top snags, or abandoned raptor, corvid, or squirrel nests. They may not be dependent on late-successional habitat in other parts of their range. In southern Oregon, some nests are located in clear-cuts or open areas. All known nests in the Butte Falls Resource Area are in or near late-successional conifer stands.

Great gray owl diet consists mostly of small mammals, especially voles and pocket gophers. The young leave the nest before they can fly and need leaning trees or a dense canopy to enable them to climb up off the ground.

A great gray owl was detected during surveys in Morine Creek drainage. No nest was located on follow-up visits. Suitable habitat exists in the Elk Creek Watershed. No historical records of population numbers of great gray owl exist. Timber harvesting, whether clearcuts or even-selective removal of large-diameter trees, has reduced nesting opportunities for all raptors, including great gray owls.

Studies show logging can and does generate “temporary meadows” capable of supporting rodent populations used by breeding great gray owls. Unlike naturally-occurring mountain meadows, forest clearings created by logging undergo rapid forest reestablishment. However, successional development makes the usefulness of such openings short-lived. Historically, fires in the western Cascades created a complex mosaic of stands in forest patches. A study in the west-central Cascades found logging activity had occurred within 200 meters of all great gray nests located. This study suggests timber harvesting created “temporary meadows” with hunting perches (tree stumps and snags) suitable for the great gray owls (Habek 1994, 196).

Post-fire

The fire created large open areas with little vegetation. These areas could be used by great gray owl as “temporary meadows” until the vegetation recovers in 5-10 years. The current condition of a mosaic of large openings with patches of green trees would favor the great gray owl. Small mammal prey (primarily voles and pocket gophers) populations may be reduced because of the fire, but they are expected to recover within one to five years.

Surveys were conducted in 2003 along the meadows and lower elevations in the Elk Creek Watershed. No great gray owls were detected.

Fisher (Bureau Sensitive)

Pre-fire

The fisher (*Martes pennanti*) is a medium-sized member of the weasel family. Fisher are thought to be associated with dense, mature, and old-growth stands. They have been considered obligate late-successional mammals in the Pacific Northwest (Powell 1982, 39). Fisher habitat is mature and old-growth forests often associated with riparian areas.

A 5-year study to determine the current distribution and conservation status of fishers in southwest Oregon was completed by US Forest Service Pacific Northwest Research Station in the spring of 2002. This study occurred in the Prospect Ranger District, Rogue River National Forest. The final report is not available at this time. Preliminary reports show the fishers in the southern Oregon Cascade Range represent a reintroduced population. These reports also indicate adult female fishers use cavities in live trees and snags for maternal dens (Raley and Aubrey 2002, 8). Some of the cavities were created by pileated woodpeckers, others were natural cavities created by heart rot.

During the study, fishers were detected on USFS lands in the Bitter Lick Creek area in the Elk Creek Watershed. Although no fishers have been documented on BLM-administered lands in Elk Creek, they are suspected to be present.

Post-fire

High and moderately burned areas are not considered habitat for fishers. Low burn severity areas may still provide adequate canopy. Fishers seem to prefer forests with continuous cover. Fishers use snags, live trees, and logs and are associated with dense-canopied, late-successional forests at relatively low elevations.

The US Fish and Wildlife Service completed an initial, 90-day review of a petition seeking to list the fisher as endangered in its wet coast range. On July 10, 2003, a 12-month status review was initiated to determine if listing the population is warranted (*Federal Register* Vol. 68, No. 132, July 10, 2003, 41169-41174). The USFWS will proceed with a status review and will decide within the next 12 months whether the petition is warranted and if the species will be listed as a threatened species.

Red Tree Vole (Survey and Manage)

Pre-fire

The Red Tree Vole (*Arborimus longicadus*) is a largely arboreal vole native to western Oregon. Habitat is mesic

forest dominated by Douglas-fir. Although red tree voles may occur in younger stands, old-growth forests seem to provide optimum habitats. Red tree voles build nests on suitable foundations such as large tree limbs, whorls, and the nests of birds or squirrels. They feed mostly on fir needles, bark, and lichens (Verts and Carraway 1998, 310). Red tree vole nests have been observed in the Elk Creek Watershed. They are an important prey species for spotted owls.

Post-fire

Some nests were likely destroyed. Red tree vole surveys were conducted in the late summer and fall of 2003. Sixty-four red tree vole nests were found in green stands in the watershed. Population numbers are unknown.

3.12.2.2 Cavity and Down Wood Dependent Species

Pre-fire

A review of wildlife species identified in DecAID which use snags, down wood, and cavities identified 47 wildlife species associated with down wood (includes downed logs, branches, and root wads in any context), 64 species associated with snags, and 29 species associated with tree cavities. Some species, such as pileated woodpeckers, were included in all three categories.

Primary excavators create cavities which are used by other species (secondary cavity users). Secondary cavity users include bats (roosting), flammulated owl (nesting), or flying squirrels (hiding or nesting). Seven bird species and one mammal species were identified as primary cavity excavators present in Elk Creek Watershed.

Bats use cavities in live trees and snags, as well as rock crevices, mines, caves, stumps, loose bark, bridges, buildings, and other protected sites. Two species, Townsend's big-eared bat and fringed myotis are on the sensitive species list. Townsend's big-eared bat hibernates in caves and mines during the winter. Individual Townsend's big-eared bats were found hibernating in a basalt cave near the mouth of Elk Creek. Fringed myotis is a crevice dweller found in crevices in mines, caves, rocks, and large conifers.

Four other species of bats were listed in the NFP as protection buffer species (USDA and USDI 1994b, C-43). These were silver-haired bat, long-eared myotis, long-legged myotis, and pallid bat. These bats are crevice dwellers and may use crevices under loose bark and in decaying stumps, or wedge into spaces in tree bark. Some species may roost in cavities created by rot or excavated by woodpeckers.

Some mammals which are important prey species for the spotted owl use down wood. Dusky-footed woodrat (*Neotoma fuscipes*) build stick nests, sometimes incorporating logs as a part of the structure. They also may fortify hollow logs with sticks to use for dens. Other prey species, such as western red-backed vole (*Clethrionomys californicus*) use sound logs for travel lanes and rotting logs for foraging, nesting, or internal travel routes. Moisture in and under rotting logs is involved in production of fungi, which is the main food for northern flying squirrel (G*laucomys sabrinus*) and western red-backed vole.

Past harvest practices, including the removal of snags during harvest and extensive salvage programs, have reduced snag numbers on Federal lands. Fire exclusion has reduced the number of snags created in the past.

Post-fire

The Timbered Rock Fire caused the loss of snags, stumps, and trees with loose bark. Down wood was also burned. This reduced habitat for species dependent on these features. The fire caused a decrease in the prey species that use cavities and down wood, such as woodrats, bats, and voles, as well as invertebrate species. These prey species are eaten by raptors such as spotted owl, bobcats, weasels, and shrews. A decline in these prey species is assumed to have occurred due to the fire.

Primary cavity excavators would have a greater number of snags available post-fire. With the increase in insect populations that occurs as an immediate result of the fire, there would be an expected increase in the productivity of the woodpeckers and insectivores in the next few years.

Trees killed by fire do not provide habitat features, such as loose bark and holes created by decay for primary excavators immediately after a fire. These structures develop over time, usually more than one year, as the trees decay or are worked by primary excavators searching for insects or excavating nests.

Late seral forests burned with low/very low severity have patches of snags within the green stands. Over time, some of the trees within the burned stands would be excavated by primary excavators. Some fire-scorched trees will die and fall to the ground, creating openings and trees with broken limbs, holes, and defects. This would create a late seral stand containing small openings with deformed trees and snags scattered throughout the stands. Previously harvested stands would return to a condition which more closely resembles a more natural, unmanaged condition. Over time, snags would fall, creating down wood structure on the forest floor. The number of cavity and down wood dependent species would increase over time.

3.12.2.3 Other Species of Concern

The following species are not late-successional, cavity, or down wood dependent. They may use components of late-successional habitat. For example, bald eagles use large trees for nesting.

Bald Eagle (Federally Threatened)

Pre-fire

In southwest Oregon, the majority of bald eagle nests are in large trees near lakes, rivers, and ponds. Bald eagles (*Haliaeetus leucocephalus*) feed on salmon and fish in Elk Creek and forage in the open meadows in the lowlands along the creek. Eagles build their nests in large dominant overstory trees, often at the edge of a stand or on a ridge. The nest trees have broken or deformed tops and/or large branches to support the nest. No bald eagle nests are known to be present within the Elk Creek Watershed. Two bald eagle nests are located adjacent to the watershed; one near the confluence of Elk Creek and the Rogue River and another south of Lost Creek Lake.

A proposal to remove the American bald eagle from threatened status was considered by USFWS in 2000. A determination was made to delay the decision until more information is processed. They remain a threatened species.

Post-fire

Bald eagles have been observed foraging in the area along Elk Creek since the Timbered Rock Fire. Young were produced at both nests in the adjacent watersheds in 2003.

Peregrine Falcon (Bureau Sensitive)

Pre-fire

Habitat for peregrine falcon (*Falco peregrinus*) is primarily tall cliffs. Forested lands provide habitat for prey species for the falcons. Peregrines prey almost entirely on birds. There are suitable cliffs within the Elk Creek Watershed. Some of the cliffs were surveyed for falcons prior to the fire. One confirmed active site occurs within the Elk Creek Watershed, approximately two miles outside the fire perimeter. An additional nest is known to be present approximately one-half mile north of the Butte Falls Resource Area boundary.

The peregrine falcon was listed as a USFWS Threatened species, but was delisted in August 1999. At that time, the BLM added the species to its Bureau Sensitive list, which has similar mitigation to Federal listing.

Post-fire

Since the known nest is two miles from the fire area, there was no change from pre-fire conditions. Surveys of suitable cliffs in the fire area in 2003 were negative.

Land Birds (Neotropical migrants and year-round residents)

Pre-fire

Land birds use a wide variety of habitats, including late-successional forests, riparian areas, brush in recovering clear-cuts, or small trees in developing stands. Some birds, such as the olive-sided flycatcher, perch on residual canopy trees and forage over clear-cuts. Many land birds are associated with deciduous shrubs and trees in early successional habitats (i.e., orange-crowned warblers and rufous hummingbirds). Any action which changes or removes vegetation used by one species may benefit another. For example, thinning in the understory may affect a species which uses dense understory, such as winter wren, but benefit other species, such as Hammond's flycatcher, which forage in the open mid-story.

Neotropical migrants are those birds that migrate to Central or South America each year. No Neotropical migrant songbirds are listed as endangered or threatened on the BLM Medford District. In February 2003, USFWS released a list of species of migratory non-game birds that are identified as birds of conservation concern (*Federal Register* Vol. 68, No. 25, 6179). Six of the birds on this list are known to occur on the BLM Medford District (see Table 3.12-1).

Table 3.12-1. USFWS Migratory Non-Game Birds of Conservation Concern for Medford District BLM

Species	Presence in Elk Creek Watershed
Peregrine falcon	Present
Flammulated owl	Suspected
Olive-sided flycatcher	Present
Rufous hummingbird	Present
Lewis' woodpecker	Not Known
White-headed woodpecker	Not Known

Resident birds remain in the same general area or migrate to lower elevations in the winter months. The pileated woodpecker, which remains in the same territory all year, and the dark-eyed junco, which winters in the lower elevations and returns to the mountains to nest, are examples of resident birds.

Post-fire

An increase in habitat for species dependent on early seral habitat occurred in the areas where the fire burned with moderate and high severity. Species such as the rufous hummingbird which use nectar-producing plants would benefit from the increase in forbs and flowering shrubs that occurs after a wildfire. This increase would continue until the tree canopy recovers and shades out these plants.

There was a loss of late-successional habitat in the watershed due to the fire. Birds that use mature and old-growth trees, such as brown creepers, would have reduced amounts of late-successional forest available. No information is available about population numbers of late-successional dependent migratory or resident birds. Unburned late-successional

habitat remains scattered throughout the burn area, but in reduced amounts.

Snags adjacent to openings would improve foraging opportunities for birds such as olive-sided flycatchers which perch in tall trees and forage over forest openings. Increased snag numbers provide improved foraging for many species of woodpeckers and other birds that glean insects from dead trees.

Big Game

Pre-fire

Deer and elk are not late-successional dependent species. They depend upon early seral vegetation for forage and need dense vegetation for hiding cover for fawning or calving and to escape predators. The watershed provides important winter range for both deer and elk. Results from a study of elk in northeastern Oregon indicated that the thermal cover benefit provided by late-successional forest with high canopy cover does not play a role in elk survival (Duncan 2000, 2). However, thermal cover in southwestern Oregon may be important for deer and elk to escape the high temperatures of summer.

The Medford District RMP designated a Big Game Winter Range and Elk Management area near Burnt Peak, outside the watershed. The area between Elk Creek and Lost Creek (Tatouche/Burnt Peak) is within the Jackson Access and Cooperative Travel Management Area (JACTMA), a cooperative road closure agreement with ODFW, Boise Corporation, BLM, USFS, and private landowners. Roads closures from mid-October through April benefit big game by reducing road hunting and poaching. For a discussion of big game in Elk Creek, see Elk Creek Watershed Analysis (USDA and USDI 1996, II-52).

ODFW recommends road density reduction and habitat improvement projects, such as prescribed burns on south aspect hillsides, to maintain or improve big game habitat. Currently, 46,000 acres (53 percent of the watershed) in the southwest one-third of the watershed is classified as big game winter range by ODFW. This area is primarily located within the proposed Elk Creek Dam pool and the ridge between Elk Creek and Lost Creek.

Post-fire

If Federal lands in the watershed were allowed to mature to late-successional condition, ODFW is concerned there would be a decrease in foraging habitat for deer and elk. However, private lands in the watershed would continue to provide forage, as they are generally maintained in early to mid-seral condition. The Timbered Rock Fire created large areas of young vegetation with a flush of nutrients. As vegetation recovers from the fire, big game would benefit.

Terrestrial mollusks (Survey and Manage)

Pre-fire

Two species of survey and manage terrestrial mollusks (snails) that use late-successional habitat are known or suspected to occur in the Butte Falls Resource Area. These species are the Chace sideband (*Monadenia chaceana*) and Crater Lake tightcoil (*Pristiloma arcticum crateris*) (USDA 2001).

The mollusk species identified as survey and manage were considered to be species associated with late-successional habitat when they were identified in the NFP. Subsequent surveys have determined this is not always the case. Oregon shoulderband (*Helminthoglypta hertleini)* were found in damp grassy areas, oak woodlands, and shrublands, or in conifer forests closely associated with these habitat types. *Monadenia chaceana* were found in talus or in conifer forests under logs or duff (see Table 3.12-2).

Although mollusk surveys have not been completed in the watershed, they were completed in adjacent watersheds to the east, west, and south. One suspected *Monadenia chaceana* was found near Clark Creek, more than six miles from the watershed. During surveys for fuels projects outside the watershed between Elk Creek and Lost Creek Lake to the east, 33 *Helminthoglypta hertleini* were found in the grass and oak woodlands. Analysis of survey data determined *Helminthoglypta hertleini* are not late-successional, old-growth habitat dependent and surveys are no longer required (USDA and USDI 2003).

Table 3.12-2. Special Status Mollusk Species

Species	Status	Habitat
Oregon shoulderband *Helminthoglypta hertleini*	Bureau Sensitive	Found in talus, under rocks, moss, and woody debris in grasslands and shrubby areas. Also found in roadside talus. Not late-successional dependent.
Chace sideband *Monadenia chaceana*	Survey and Manage	Open talus or rocky areas in conifer forests.
Crater Lake tightcoil *Pristiloma arcticum crateris*	Bureau Sensitive Survey and Manage	Known sites south of Crater Lake, moderate to high elevation. Microhabitats include moist to wet sites in riparian areas, near springs, seeps, wetlands, and meadows. Have not been found in the Medford District.

Post-fire

High and moderate burns removed all understory vegetation. It is assumed all mollusks in these areas were burned unless they were underground or in rock crevices which did not receive enough heat to kill them. The fire removed the forest overstory canopy. These areas are no longer considered habitat for late-successional associated mollusks.

Some mollusks in areas underburned with less severity may have survived. These areas burned in a mosaic pattern and patches of vegetation on the forest floor remained green after the fire. Overstory canopy remains in varying amounts in these areas. These areas would provide a source population for mollusks to repopulate the burned area.

3.12.3 Environmental Consequences

- The Timbered Rock Fire burned about 8,000 acres of late seral forest which provided habitat for wildlife dependent on older forests.
- Approximately 2,000 acres were burned with high and moderate severity, changing late seral to early seral condition.
- Early seral forest on BLM land increased by 17 percent as a result of Timbered Rock Fire.
- Early seral habitat created by the fire improved forage for great gray owl, deer and elk, and rufous hummingbird.
- Light underburns occurred in approximately 6,000 acres of late seral forest. The fire removed the understory and killed some trees in these areas, creating snags and an open understory in the green stands.
- Approximately 10,400 acres of late-successional habitat remains the in Elk Creek Watershed post-fire.

3.12.3.1 Species Associated with Late-Successional Habitat

Northern Spotted Owl

- Little published literature describes spotted owl use of stands killed by wildfire that would assist in determining impacts.
- No published literature has tracked owl use of moderate or severely burned stands before versus after salvage logging.
- Impacts to owls depend mainly on:
  - Whether owls have returned to the historic activity center or not, or is the site predicted to remain active post-fire.
  - The quantity of burned acres to be salvaged within a ¼-mile radius of the activity center.

Effects Common to all Alternatives

Salvage

Direct and Indirect Effects

The NFP was intended to serve as the Federal contribution to the recovery of the northern spotted owl. LSRs were designed to support a breeding population of owls. Critical habitat for the species is to provide primary constituent elements of owl habitat. Stands of dead trees greater than 10 acres burned at moderate or high severity are no longer considered mid- or late-successional LSR habitat or suitable owl habitat. It is assumed, due to proximity and site tenacity, burned stands in owl activity centers still have value to owls.

Surveys to determine location and status of post-fire owl activity centers would take place each year in April through August. The 2003 survey results are shown in Appendix table N-3. References to historic owl activity centers denotes pre-fire owl pair locations. One center (Timbered Rock - lone male) shifted one-half mile south in 2003. Other owl centers could shift in subsequent years.

Unanswered questions concerning spotted owls and wildfire include:

- How are owl occupancy, foraging, and productivity affected by patchy burns or large stand-replacement fire?
- Does owl use of an area for roosting/foraging decrease after half the snags are salvaged?

It is assumed burned stands closest to the activity center could receive more post-fire use by surviving owls than similar stands further from the owl center. In the absence of answers, all Alternatives, except for E, take a conservative approach by not entering potential harvest units within one-fourth mile of owl activity centers predicted to remain active post-fire. To shed light on the above questions, an owl radiotracking study has been initiated. The research will not yield results in time for use in this EIS.

In *A literature review on the environmental effects of postfire logging* (McIver and Starr 2001, 162-163) there are no references to spotted owls or other raptors. For spotted owls, the risk threshold is unknown for removal of dead stems, as long as minimal snag densities are maintained. The assumption is the more dead stands salvaged, especially closer to the pre-fire owl activity centers, the slower would be the recovery of owl productivity due to impacts to the close-in prey or due to loss of potential nesting structures.

Neither the NFP Standards and Guidelines nor the South Cascades LSRA address special management for owl activity centers within an LSR. These documents direct that the entire LSR be managed to promote late-successional forest characteristics.

The effects analysis for the action alternatives addresses salvage using two scenarios. First, if the owls returned to

the historic activity center in 2003, the burned area within a quarter mile is presumed to have value to the owls. Second, if no owls are present during the 2003 survey, the burned stand is presumed to have no value to owls and there would be no impacts. If owls did not reoccupy an historic center in 2003 or 2004, it is unlikely owls would reoccupy the site in 2005 or 2006, whether burned trees in the activity center were salvaged or not.

A site is considered to be reoccupied even if only a single owl is detected. Some mates are not responsive to surveys, or could be hiding on a nest. Owl pairs in southwest Oregon commonly nest every other year. Resident owls not breeding in a given year is not a reason to downgrade the viability of the site.
For analytical purposes, it is assumed salvage sales would occur in spring 2004, with seasonal restrictions applied between March 1 and June 30 near historic owl activity centers (from USFWS, 2003 programmatic consultation BO, Appendix A-3 Project Design Criteria). This would provide two seasons of surveys to determine owl presence before salvage commenced. The Biological Opinion that addresses the Timbered Rock project, as well as other proposed actions on BLM and USFS in SW Oregon for FY 2004 through 2008, was signed on October 20, 2003. See Appendix N, Wildlife, BO Citations, for excerpts relating to spotted owls and Timbered Rock.

Assuming owls still occupy the site, the highest direct impact of the action alternatives would be removal of dead timber within a ¼-mile radius of the activity center. Anecdotal evidence implies owls often return to their historic activity center due to site tenacity, even though a portion has burned severely. Remaining dead trees could have suitable cavities for owl nesting. Some prey may be available in the burned stand. Pre-fire, owls had settled in those activity centers for reasons not fully understood. Although some of the stands were burned severely, the goal would be to retain as many legacy components as possible while the stand regrows to become suitable habitat.

In the DEIS, nine owl sites were identified as having a high probability of owls returning: Alco Rock, Alco Rock West, Elkhorn, Flat Creek, Timbered Rock, Upper Timber Creek, West Branch Elk, and Hawk Creek (half on USFS). These sites were predicted to remain occupied because at least 150 acres of suitable (albeit underburned) habitat remained within one-half mile, and consistent occupancy with attempted nesting had occurred in recent years. Two additional sites (Miller Mountain and Alco Creek) remained occupied in 2003. There is always some turnover from year-to-year in individual owls at a site, but the remaining mate usually attracts a new mate to maintain pair occupancy. A pair is capable of shifting the nest location in a subsequent year to be outside the original ¼-mile analysis area.

Two other recently active sites (Lower Timber Creek and Shell Rock) retain relatively little green timber (less than 100 acres) within one-half mile. These sites are predicted to not remain active. There could be area salvage units within ¼-mile radius of these activity centers.

An additional six sites (Alco Ridge, Flat Creek Divide, Gobblers East, Middle Creek, Ragsdale, and private land on East Jones Creek) have been vacant the past five years. Proposed salvage units exist within one-quarter mile of owl activity centers. The probability of owls relocating to these areas is low.

In the absence of data documenting the potential importance of burned units close to owl activity centers, Alternatives C, D, F, and G, have no "area salvage" units within the ¼-mile radius of the 11 sites presumed to still be active. However, limited harvest would still occur within research units in Alternative G within one-quarter mile. Reserving burned stands within one-quarter mile will preserve habitat options as the stands slowly grow into late successional/old-growth (LSOG) habitat. The main factor needed to return these stands to late-successional forest is time (decades).

With the goal of moving burned stands to an LS/OG character as soon as possible, there would be no appreciable difference between the action alternatives. Legacy snags and CWD would be maintained in each alternative. Future treatments, such as thinning, fertilization, and brush control in out-years, would hasten growth.

Irwin (2003, 17) asserts that a proportion of young second-growth forest contains high quality foraging habitat. For the Medford District, stands are classified as owl foraging habitat when they reach 60-80 years of age.

Under Alternatives C, D, F, and G, if a new owl center is discovered as birds shift to more optimal habitat, any proposed units within the ¼-mile radius would not be harvested. Under all alternatives, if a new owl center is discovered, a seasonal restriction would be implemented until the mitigating measures could be studied (see Section 2.3.1.3, PDFs). The seasonal restriction would be employed within one-quarter mile of all historic activity centers every year, until the annual survey demonstrates the site is vacant.

If owls have abandoned the site, there would be no impact in terms of habitat degradation. Analysis for each alternative has been considered on 3 spatial scales: within ¼ mile (125-acre activity center), ½-mile radius (500-acre high-use core area) of each historic owl center, and within the entire fire area, as displayed in the Appendix N tables.

In addition to "area salvage" units, trees identified as hazard trees along roads would be felled and salvaged as appropriate. Roadside hazard trees within owl activity centers would be felled regardless of whether the site was active, but logs would be left on-site. Depending on the

alternative, only 5-12 percent of the roadside hazard areas burned at high or moderate severity, which means relatively few trees per acre would be felled over 90 percent of the proposed roadside hazard project. The impact of habitat alteration would be negligible, regardless of the alternative selected.

Restoration

Direct and Indirect Effects

Seven historic, plus one newly delineated, owl activity centers (six active and two vacant, Appendix N, Table N-3) exist outside the fire perimeter but within the LSR and may be affected by various restoration projects. An additional five historic sites on the east side of the watershed located on lands other than BLM are at least one-half mile from any proposed restoration activities and would not be impacted.

Ridgeline FMZs (400 to 600 foot-wide strips) outside the burn would slightly degrade owl foraging habitat due to removal of stems 8" DBH and less. Most proposed FMZs within the fire perimeter have already burned and are no longer suitable habitat. Remaining green trees would not be felled. Disturbance from felling, yarding, and pile burning would be temporary and would take place outside the nesting season. Approximately 17 miles of FMZs could cover up to 1,300 acres (500 acres inside the burn and 800 acres outside the burn). Only four acres would pass within one-quarter mile of an owl activity center, and that FMZ is predominantly green trees at the Timbered Rock site. Acres of proposed FMZs near owl activity centers are compared by alternative in Appendix N, Table N-6. Because only smaller diameter trees and brush would be removed, the canopy would be minimally altered. The “edge” created by the FMZ would be minimally different from adjacent suitable habitat. The ridgeline strips would not be drivable.

Short-term noise disturbance would be offset by the long-term “insurance value” FMZs would provide to reduce the risk of large stand-replacement fires in future decades. As a result, the project would be an overall benefit to owls and LSR forest conditions. Stem spacing and reduction of ground fuels along the ridgeline FMZs would be maintained in future treatments, so the FMZs would remain owl dispersal habitat long-term. Since suitable habitat would be slightly degraded, this portion of the project would be “May Affect, Likely to Adversely Affect.”

Creation of ridgeline FMZs could be perceived as creating “edge” and removing suitable owl habitat. Recent research (Franklin, et al. 2000, 579, 580; Zabel, et al. 1994, 437) indicates that owl productivity is enhanced by having an edge component in the home range. Woodrats, the primary prey of spotted owls, are more vulnerable for predation at habitat edge openings.

A separate project would underburn up to four historic owl centers of activity. Of the four proposed units, Gobblers Knob is an underburned site predicted to remain active, Middle Creek is an underburned stand predicted to be vacant, and Lower Timber Creek is a severely burned vacant site. The fourth (Oliver Springs) is an active but unproductive pair outside the fire perimeter.

The project is intended to use several follow-up light burns, if appropriate, at 2-3 years, and again at 5-10 years to reduce ground fuels. The treatment would only be used if fuels reached specified levels. The short-term disturbance of the underburn is preferable to the risk of a future stand-replacement fire in the activity center. Underburning of owl activity centers has not been undertaken on Medford District BLM before, so this project may be viewed as untested. Underburning would take place outside of the nesting season.

Commercial thinning of 30-80 year old stands outside the burn would involve short-term (up to several weeks) noise disturbance. These stands are not classified as suitable nesting/roosting/foraging (NRF) owl habitat. There are lower density prey populations in these units whose habitat would be disrupted by the thinning for several years. These stands offer limited foraging value to the seven intermingled owl sites just outside the fire, as well as to owls within the fire perimeter making foraging forays into the thinning project areas. Acres of proposed commercial stand thinning near owl activity centers across alternatives range from 466 to 820 acres (see Appendix N, Wildlife, Table N-8).

A radio-tagged owl in a study in northwest Oregon showed greatly reduced foraging/roosting use in recently thinned stands, as compared to pre-treatment (Meiman, et al. 2002). In the long-term (5-10 years), the foraging/roosting habitat would improve as the stand trajectory is pushed toward late-successional/old-growth (LSOG) habitat. Seasonal restrictions (March 1 to June 30) would be applied to units within one-quarter mile of an owl activity center. This project would be a benefit to owls and LSOG habitat.

Pre-commercial thinning of 10-30 year stands would be of no short-term impact to owls as long as a noise disturbance seasonal restriction was imposed on any units adjacent to an activity center. As with the thinning of older stands, growth into older seral character would be hastened. Acres proposed for treatment in each alternative range from 862 to 1,102 acres (see Appendix N, Wildlife, Table N-7).

Pine restoration projects would thin around selected pines to achieve spacing to promote growth of larger pines. In Alternatives C, D, and G, 793 acres would be treated. In Alternative E, 2,005 acres would be treated. There would be minimal overlap of treatment units within one-half mile of any active owl sites. Effects would be similar to the other thinning projects – short-term disturbance and degradation of foraging quality to achieve a long-term benefit.

Additional restoration projects such as fish structures, stream-crossings, pump chance reconstruction, rock quarry closure, oak woodland thinning, and log piles for wildlife habitat would have minimal effect on owls and their habitat. Road projects would have minimal impact as long as seasonal restrictions were employed when near owl activity centers and new spurs were blocked following use. Much of the road network had natural blockages (slumps, brushed over, downed trees) pre-fire. With proposed road renovation, there would be an increase in access that could lead to slightly increased human disturbance, while the amount of suitable habitat has been compressed. All new helicopter landings except one would be cleared in areas where the trees are already dead. Reforestation would not benefit spotted owls until replanted areas grow to at least 30 years old and supported marginal foraging.

Cumulative Effects

The major impact to the spotted owl and the watershed occurred during the wildfire and during the subsequent salvage operations on intermingled private industrial forest land. While not classified as suitable foraging habitat, the private lands pre-fire (30-80 years age) augmented the prey base. Impacts to owls from the proposed array of BLM salvage and restoration activities would be of considerably less magnitude than the changes occurring from the fire and related actions.

Impacts from suppression activities during the fire were relatively minor. Dozer lines degraded negligible amounts of suitable habitat. Most burnout areas were underburned, rather than stand replacement, so most remain as temporarily (2-5 years) degraded suitable habitat for owls.

Adjacent watersheds were analyzed for cumulative impacts. BLM sold the Flying Lost, B Lost, and Round Forks timber sales to the southeast, removing 1,460 acres of suitable habitat. To the west, North Trail and South Trail timber sales and fuels treatments sold in September and August 2003, removing 2,086 acres of suitable habitat. Originally planned for 2004 but now delayed, the Flounce Around timber sale and fuels treatments to the east of the project area in the adjacent watershed would remove approximately 467 acres of suitable habitat. Those actions are on Matrix lands, and were included in programmatic consultations with USFWS.

Suitable owl habitat within a 10-mile radius outside the Elk Creek Watershed comprised 34.8 percent of the BLM-administered land when the NFP was implemented in 1994. The above listed timber sales would reduce suitable habitat to 30.6 percent.

USFS has no sales projected for the next five years to the north (LSR 222). USFS has a sale to the east at Mill Creek. Intermingled non-Federal lands within and surrounding the watershed could have logging activity in the next five years. None of the non-Federal acreage is classified as suitable owl habitat.

Logging in adjacent watersheds reduces the amount of suitable habitat on a landscape basis, increasing the importance of the role of the LSR to support owl productivity. The cumulative impact of the adjacent sales was magnified by the wildfire. The loss of a relatively large amount of suitable habitat in the fire could have a long-lasting (decades) effect on the reproductive potential of the 13 pre-fire active owl sites. Home ranges of returning owls would probably increase in size, with the owls spending more time foraging within the home ranges of existing owl sites outside the fire. Previous productivity averaging a total of 4.4 young per year within the LSR would be predicted to average 1 or 2 for the next 5 years.

Prey species populations are expected to rebound in underburned areas within 2-5 years, but the older seral structure in the high and moderate burn severity stands would not recover to support the prey population for 40-60 years. In adjacent watersheds, red tree voles are not found in younger stands. There are prey populations such as woodrats in younger seral stands, but extensive telemetry studies have shown owls make much less use of younger stands relative to the availability of that habitat (Forsman, et al. 1984, 24-25; Solis and Gutierrez 1990, 739). One study documented owls repeatedly foraging in stands as young as 27 years (Irwin, et al. 2000, 175). Spotted owl prey exists in young stands, but owls avoid hunting in these stands, probably due to vulnerability to predation by great horned owls.

The entire LSR is designated as spotted owl Critical Habitat (CHU OR-34). An incidental take permit for logging within CHU OR-36 to the south of Lost Creek Reservoir, and the upcoming logging in portions of CHU OR-34 in Trail Creek were included in the USFWS programmatic consultation (USDI, USFWS 2001b). The Biological Assessment (18 July 2001, 20) states, for Southwest Oregon CHUs, " …approximately 304,000 acres (78 percent) are within the boundaries of LSRs or other land allocations with no programmed timber harvest (CHU suitable habitat in the action area is protected in LSRs, Congressionally reserved areas, etc.)." Fire salvage within LSR 224 (CHU OR-34) is not considered a programmed timber harvest.

The Biological Assessment for SW Oregon discusses spotted owl suitable habitat, LSR intent, dispersal habitat, wildfire effects, and critical habitat (USDI 2003, 40-50).

USFWS released a programmatic Biological Opinion (BO) October 20, 2003 that includes the Timbered Rock project. Relevant quotes are listed in Appendix N section "BO Citations." The BO discusses impacts of area salvage and restoration projects. The current condition and impacts to Critical Habitat are discussed, as well as connectivity and dispersal. "The remaining 20,832 acres of NRF remaining

in this CHU should provide sufficient NRF for the known spotted owls within the CHU and also continue to provide dispersal habitat for spotted owls in both N-S and E-W directions." (USDI 2003, 77). An incidental take statement was included.

There were other nearby fires in 2002. To the west, the Wall Creek Fire covered 316 acres, with 210 of that on BLM, and 150 in suitable owl habitat, with half of that burned at high to moderate severity. The Berry Rock Fire covered 34 acres to the southwest within the Elk Creek Watershed, but none of the burn was in suitable habitat. To the north on the Umpqua National Forest, 88,000 acres burned at variable intensity in multiple fires (Tiller Complex, Apple). The Timbered Rock Fire was analyzed along with other fires in the Cascades Province in the *Wildfire Effects Evaluation Project* (USDA 2003).

Cumulative effects of proposed restoration activities would be minimal relative to the habitat degradation of the past year. Projects are designed to have long-term beneficial effects in terms of enhancing LSOG habitat conditions and providing some protection (FMZs) to remaining late-successional habitat within the area.

Even with the increase in habitat fragmentation, over 20 percent of the burn area remains in dispersal habitat (5,770 acres on BLM) to enable genetic interchange. Older seral stands are not required for dispersal habitat (defined as 11" DBH with 40 percent canopy closure). Dispersal habitat includes Riparian Reserves, lightly thinned stands, and FMZs, as well as suitable habitat. Despite the 2002 fires and recent timber sales, the network of patches of dispersal habitat would be maintained across the landscape for decades.

"Although large areas of non-forested habitat appeared to inhibit dispersal, spotted owls regularly dispersed through the highly fragmented forest landscapes that were typical of the mountain ranges in western Oregon and Washington." (Forsman, et al. 2002, 22).

Acres of treatments within ¼-mile and ½-mile radii of owl centers have been updated in the Alternative G (Preferred Alternative) discussion. In most cases, acres of overlap have been reduced from the DEIS.

Effects of Alternative A (No Action) on Northern Spotted Owl

Salvage

Direct and Indirect Effects

Under Alternative A, no area salvage would occur. If burned stands near activity centers have value, there would be no risk of habitat degradation. The only snag habitat removed would be a limited number of roadside safety hazard trees.

Restoration

Direct and Indirect Effects

Reforestation planting on 10'x10' spacing on 6,000 acres will occur under the ESRP. No restoration projects would be implemented. If not thinned, 30-80 year old stands would continue to grow on a slower trajectory. No FMZs would be created, which would leave the risk of spread of future stand-replacement fires at the current situation.

Cumulative Effects

Cumulative effects under Alternative A would be the same as Effects Common to all Alternatives.

Alternative A would be a "No Affect."

Effects of Alternative B on Northern Spotted Owls

Salvage

Direct and Indirect Effects

Under Alternative B, effects would be the same as Alternative A.

Restoration

Direct and Indirect Effects

Construction of up to 1,300 acres of ridgeline FMZs would reduce the risk of the spread of future stand-replacement fires. There are 24 acres of FMZs a ¼-mile radius of 4 activity centers. There are 352 acres within a ½-mile radius of 12 activity centers. Adverse impacts will be low, with long-term beneficial "insurance value." Other impacts are the same as discussed previously in effects common to all alternatives.

Thinning of 10-30 year old stands would have the same short-term disturbance and long-term benefit as discussed in effects common to all alternatives. There would be 46 acres of thinning within ¼-mile of 5 activity centers. There would be 192 acres within the ½-mile radius of 5 activity centers. Impacts would be minimal.

Riparian thinning is proposed for 1 acre within ¼-mile and 24 acres within a ½-mile radius of 3 activity centers. Impacts would be minimal.

Cumulative Effects

With implementation of seasonal restrictions (PDFs) on projects near active owl centers, this alternative would be a "No Affect" regarding Section 7 consultation.

Effects of Alternative C on Northern Spotted Owls

Salvage

Direct and Indirect Effects

Of approximately 1,350 acres in proposed units with less than 40 percent canopy, exceeding 10 acres and meeting LSRA snag retention levels, 10 to 20 percent of each unit would be cut, with up to approximately 247 acres to be harvested.

No units would overlap a ¼-mile radius activity center of the 9 owl sites predicted to remain occupied post-fire. Within a ½-mile radius, 139 acres would be considered for entry in 8 of the 9 sites.

Of four formerly active sites now presumed vacant, plus six sites vacant before the fire, there would be 110 acres of harvest overlap within the ¼-mile radius. Up to 20 percent of each unit would be harvested, so the impact would be lessened. As a mitigating measure, when the 20 percent for each unit was selected, if the activity centers were avoided, impacts would be reduced. Within a ½-mile radius, 284 acres would be considered for entry in 6 of the 10 sites.

Those totally burned acres within the old activity center would be considered as early seral, and non-suitable as owl habitat. If no owls returned in 2003 or 2004, there would be no impact from the salvage. If owls return to the activity center, the proximity elevates the risk that the burned stands out to the ½-mile radius are more valuable to the owls if left alone. If an owl reoccupied one of these 10 sites, there would be no harvest within ¼-mile.

Of the 1,350 acres in proposed units, 1,223 acres are outside the ½-mile radius.

Salvage of 1,078 acres of roadside hazard trees would overlap 56 acres within the ¼-mile radius of 8 activity centers. There are 460 acres within a ½-mile radius of 18 of the 19 activity centers. Since relatively few dead trees per acre would be felled, the effect on owl habitat would be minimal.

Regardless of whether owls were detected, proposed activities would be of relatively low impact to owls as long as the seasonal restriction project design feature (PDF) is employed on all units within ¼-mile of an historic owl center or remaining suitable habitat.

Restoration

Direct and Indirect Effects

Construction of 1,300 acres of ridgeline FMZs inside and outside the fire would reduce the risk of the spread of future stand-replacement fires. There would be 24 acres within the ¼-mile radius of 4 activity centers, and 352 acres within the ½-mile radius of 12 activity centers. Impacts would be low.

Short-term disturbance and long-term benefits would be the same as with other thinning alternatives, with 878 acres in treatment of young stands, and 557 acres in treatment of mid-seral stands (commercial thin). Effects on owls would be minimal as long as seasonal restrictions are employed. There would be 31 acres of young stand thinning within a ¼-mile radius of 3 activity centers, and 152 acres within the ½-mile radius of 4 activity centers. For older stand thinning, there would be 23 acres within the ¼-mile radius of 5 activity centers, and 122 acres within the ½-mile radius of 10 activity centers.

Cumulative Effects

Alternative C would be the least impacting of the salvage action alternatives to owls, because units overlap the least acres within ¼-mile and ½-mile radii of the fewest number of activity centers. In terms of Section 7 consultation, if owls are present at any of the activity centers, this alternative would be a “May Affect, Likely to Adversely Affect.” If no owls were present, impacts would be minimal (reduction of suitable habitat in FMZs, temporary prey disruption in underburns) with a determination of “No Affect.”

Effects of Alternative D on Northern Spotted Owls

Salvage

Direct and Indirect Effects

Approximately 820 acres of high to moderate burn severity in areas of at least 10 acres and less than 40 percent canopy closure would be entered.

No units would overlap the ¼-mile radius activity center of the nine owl sites predicted to remain occupied post-fire. Within a ½-mile radius, a total of 111 acres would be entered in 8 of the 9 sites.

Of 4 formerly active sites now presumed vacant, plus 6 sites vacant before the fire, there would be 125 acres of harvest overlap within the ¼-mile radius. Within a ½-mile radius, 314 acres would be entered in 9 of the 10 sites (see Appendix N). There would be an additional 395 acres of units outside the ½-mile radius of the historic activity centers.

Those totally burned acres within the old activity center would be considered as early seral and non-suitable as owl habitat. If no owls returned in 2003 or 2004, there would be no impact from the salvage. If owls return to the activity center, the proximity elevates the risk that the burned stands out to the ½-mile radius are more valuable to the owls if left alone. If an owl reoccupied one of these 10 sites, there would be no harvest within ¼-mile.

Regardless of whether owls were detected, proposed activities would be of relatively low impact to owls as long as the seasonal restriction project design feature (PDF) is employed on all units within a ¼-mile of an historic owl center or any remaining unsurveyed suitable habitat.

Salvage of 1,064 acres of roadside hazard trees would overlap 48 acres within a ¼-mile radius of 6 owl centers, and 415 acres within the ½-mile radius of 16 activity centers. The habitat degradation effect would be minimal since only scattered dead trees would be felled.

Restoration

Direct and Indirect Effects

For FMZs and thinning in mid-seral stands, effects would be the same as Alternative C. For young stand thinning, 32 acres within a ¼-mile radius of 3 activity centers, and 152 acres within the ½-mile radius of 4 activity centers. For riparian thinning, there would be 1 acre within ¼-mile, and 24 acres within the ½-mile radius of 3 activity centers. Impacts from these restoration projects would be low.

Cumulative Effects

In terms of Section 7 consultation, if owls were present at any of the activity centers, this alternative would be a "May Affect, Likely to Adversely Affect." If no owls were present, impacts would be minimal (reduction of suitable habitat in FMZs, temporary prey disruption in underburns) with a determination of "No Affect."

Effects of Alternative E on Northern Spotted Owls

- The risk level of adverse impacts to owls from the salvage is highest in this alternative.
- This alternative proposes the most acreage for salvage within the ¼-mile radius of the 9 predicted active sites.
- There would be no commitment to not salvage an activity center if a new owl site was discovered.
- Harvesting of small clumps of dead trees within green underburned stands degrades suitable habitat and Critical Habitat in an LSR and would not be consistent with recommendations in the South Cascades LSRA, the Medford District RMP, and the NFP.

Salvage

Direct and Indirect Effects

Approximately 3,269 acres would be salvaged. There are three owl habitat related components to the area salvage portion of this alternative.

- Salvage of stands greater than 10 acres burned at high or moderate severity (stand-replacement),
- Salvage of smaller stands of 1-10 acres size burned at high or moderate severity,
- Salvage of small clumps and individual dead trees within green stands with greater than 40 percent canopy closure underburned at low severity.

Stands of dead trees greater than 10 acres burned at moderate or high severity are no longer mid- or late-successional suitable habitat. They have been set back to zero in terms of owl habitat. Due to site tenacity and proximity, if owls return to an activity center, these burned stands within ¼-mile radius are presumed to have value to the owls. If there were no owls present, harvest of these burned stands would have no impact.

Clumps of burned trees (less than one acre) within underburned green stands (low severity burns) are still suitable owl habitat, augmenting the snag component and patchy stand structure. Burned snags in excess of four per acre could be removed. Harvest would degrade suitable owl habitat over approximately 1,300 acres.

Of 3,269 acres proposed for salvage, 219 are within ¼-mile of the 9 owl activity centers predicted to remain active. Within a ½-mile radius, 826 acres would be salvaged.

Another 240 acres within the ¼-mile radius for 8 of the remaining 10 predicted vacant sites would be salvaged. Within the ½-mile radius, 672 acres would be salvaged. Outside the ½-mile radius for all historic activity centers, approximately 1,770 acres would be entered.

An additional 142 acres within ¼-mile of 12 of the 19 activity centers would be treated for roadside hazard tree removal. Within the ½-mile radius, 468 acres are proposed for roadside hazard removal.

If owls are not present in 2003, the totally burned areas have no value to owls, and there would be no impact. Regardless of whether owls were present, removal of small clumps of dead trees within green stands would degrade suitable habitat.

If owls were present in 2003, removal of burned timber within the ¼-mile radius activity center would be impacting, due to the predicted use of the owls of any stand near their activity center. Removal of dead timber so close to the owl's historic use area would reduce the probability owls would remain at the site. The presumption is the burned stand would provide a component to the rehabilitation of LSOG character. This alternative proposes the most acreage to be cut within ¼-mile and ½-mile of the activity centers.

Although there is little published literature to demonstrate the importance of unsalvaged burned owl cores, anecdotal information indicates the pre-fire center of activity often continues to remain the owl core post-fire (Bond, et al. 2002,

1026; Ingalsbee 1998; Gaines, et al. 1997, 123; King, et al. 1998). Of the 13 pre-fire active owl pairs, some may have perished in the fire, some will shift their core area over the winter, some may shift their core area mid-summer, and some will maintain their site fidelity and return to a burned historic nesting grove. Nine sites are predicted to remain viable. This alternative would reduce the probability those sites would remain occupied.

The NFP ROD Standards and Guidelines state, "Because Late-Successional Reserves have been established to provide high quality habitat for species associated with late-successional forest conditions, management following a stand-replacing event should be designed to accelerate or not impede the development of these conditions." "Because there is much to learn about the development of species associated with these forests and their habitat, it seems prudent to only allow removal of conservative quantities of salvage material from Late-Successional Reserves and retain management opportunities until the process is better understood." "Salvage in disturbed sites of less than 10 acres is not appropriate because small forest openings are an important component of old-growth forests." "Accordingly, following stand-replacing disturbance, management should focus on retaining snags that are likely to persist until late-successional conditions have developed and the new stand is again producing large snags." (USDA and USDI 1994b, C-14).

In the Medford District RMP, objectives for LSRs include "Protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth forest-related species including the spotted owl and marbled murrelet. Maintain a functional, interacting, late-successional and old-growth forest ecosystem." (USDI 1995, 32). Naturally occurring fires and resultant large stands of burned timber are a component of the old-growth ecosystem. "Plan and implement nonsilvicultural activities inside late-successional reserves that are neutral or beneficial to the creation and maintenance of late-successional habitat. "Limit salvage of dead trees in late-successional reserves to areas where stand-replacing events exceed ten acres in size and canopy closure has been reduced to less than 40 percent" (USDI 1995, 33).

"Salvage guidelines are intended to prevent negative effects on late-successional habitat, while permitting some commercial wood volume removal." "…salvage operations should not diminish habitat suitability now or in the future" (USDA and USDI 1994b, C-13).

The South Cascades LSRA states "The core team has not found a biological rationale for salvage." "The decision to salvage must be based on site-specific conditions, with the understanding that salvage operations should not diminish late-successional habitat suitability now or in the future." (USDA and USDI, 168).

Restoration

Direct and Indirect Effects

Ridgeline FMZs are the same as proposed for Alternatives B, C, and G. Thinning of 1258 acres of 10-30 year old stands is the same as Alternative B.

Thinning of older stands (30-80 years) is 1038 acres. There would be 26 acres within the ¼- mile radius of 5 activity centers, and 174 acres within the ½-mile radius of 12 activity centers.

There would be 47 acres of riparian thinning within ¼-mile of 5 activity centers, and 325 acres within ½-mile of 11 activity centers, which is double the amount for any other alternative. The effects of the various thinnings would be short-term disturbance (disruption to low level of owl prey base) over a wider area, but in 10-20 years the trajectory of these stands to becoming suitable habitat would be hastened, and the released stands would grow larger sooner. The impact would be a long-term benefit due to the hastening of development into LSOG character over more acres.

Cumulative Effects

This alternative would have the highest cumulative impacts on owls since the most owl activity center area would be entered at sites predicted to be active and because green suitable habitat stands throughout the burn area would be entered. The impact would not be "neutral or beneficial." Owl pairs returning to underburned activity centers would be subjected to further habitat alteration during salvage. The habitat value of burned clumps within an owl center of activity is subject to speculation (a data gap). For consultation purposes, this alternative is a "May Affect, Likely to Adversely Affect."

Effects of Alternative F on Northern Spotted Owls

Salvage

Direct and Indirect Effects

Under Alternative F, approximately 213 acres in pockets of 3-10 acres of high and moderate burn severity would be entered. Two acres would be left untreated in each unit. Use by spotted owls of burned patches up to 10 acres in size has not been studied.

No units would overlap the ¼-mile radius activity center of the 9 owl sites predicted to remain occupied post-fire. Within a ½-mile radius, 53 acres would be entered in 7 of the 9 sites.

Of 4 formerly active sites now presumed vacant, plus 6 sites vacant before the fire, 24 acres of harvest would overlap the ¼-mile radius. Within a ½-mile radius, 70 acres would be entered in 8 of 10 sites. Outside the ½-mile radius of historic owl sites, another 189 acres are proposed for salvage.

Although total acres to be salvaged would be relatively small, there is a risk the pockets of dead trees less than 10 acres have value to the recovery of late-successional character.

There would be an additional 1,182 acres of roadside hazard tree removal, with 70 acres of that within one-quarter mile of 9 activity centers, and 491 acres within one-half mile of 16 activity centers. This alternative proposes the highest amount of roadside hazard treatment, since the roadside areas are not otherwise being covered in area salvage units

Restoration

Direct and Indirect Effects

There would be about 500 acres in ridgeline FMZs inside the fire perimeter, with 304 acres within one-half mile of 10 activity centers. Short-term impacts would be minimal. Fewer FMZs than other alternatives would mean a lower level of long-term insurance against spread of future stand-replacement fires. There would be no thinning projects inside or outside the fire perimeter. Not thinning younger stands would continue the status quo of a slower trajectory to achieving older seral character.

Cumulative Effects

This alternative salvages the fewest number of acres within the ½-mile radius, but those acres are in patches of less than 10 acres, which conflicts with guidance in NFP. For consultation purposes, this alternative is a "May Affect, Likely to Adversely Affect" since suitable owl habitat would be degraded.

Effects of Alternative G (Preferred Alternative) on Northern Spotted Owls

Salvage

Direct and Indirect Effects

There are three salvage components to this alternative:

- Research Units; 12 replicated 30+ acre units, with 4 replications of 3 treatments totaling 282 salvage acres (excluding "controls").
- Area salvage (679 acres) in remaining units over ten acres in size.
- Roadside hazard salvage (1,188 acres).

The randomized unit selection for the three treatments in the research design results in some units overlapping the ¼-mile activity center of occupied owl sites. Section 1.6 - Plan Consistency elaborates on the justification for the research project.

Treatment 1: Heavy Salvage" This is the only one of the three research treatments to salvage most of the unit (reserving six snags per acre). Of 4 replications, 1 randomly selected "intensive" unit overlays 35 acres of a ¼-mile radius owl center (Shell Rock). That activity center and surrounding area were totally denuded in the fire and the owl pair is not expected to reoccupy the site. There would be no impact to owls. A second replication overlaps 22 acres of an active owl center (Alco Rock). That site has additional underburned suitable habitat nearby. Research study acres within the ¼- and ½-mile radii of owl centers are shown in Appendix N, Table N-10.

Treatment 2 - Moderate Salvage. Each of the four replication units randomly selected for the second treatment overlaps owl centers of activity. Two owl sites (Timbered Rock, 21 acres of overlap; Alco Rock West, 6 acres of overlap) have remained active post-fire. If owls remain in these sites in 2004, there would be an impact from removal of timber within the ¼-mile activity center due to the probability the burned stands still have value to the owls due to proximity and site tenacity. If no owls were present in 2004, harvest of the burned stand in the old activity center would have no impact. The other two owl sites (Shell Rock, 19 acres of overlap; Lower Timber Creek, 46 acres of overlap) have relatively little suitable habitat remaining nearby, were vacant in 2003, and are not predicted to be reoccupied.

Treatment 3 - Control. Study units overlap the ¼-mile radius of 2 sites (Timbered Rock, 43 acres of overlap; Hawk Creek, 1 acre of overlap). There would be no salvage, therefore no impact would occur. Researchers would be hiking into the sites to conduct studies.

The Biological Opinion (BO) (USDI, USFWS 2003, 67) acknowledges the potential for adverse affect of the research units near the active owl sites (see Appendix N, Wildlife, BO Citations: Effects of the Action for the full context).

For the remaining area salvage portion of Alternative G, no units would overlap the ¼-mile activity center for the 11 owl sites that remained active in 2003. Within a ½-mile radius, 169 acres overlap 10 of 11 active sites (see Appendix N, Wildlife, Table N-4). For the remaining 8 sites predicted to remain vacant, 72 acres are within ¼-mile of 5 historic activity centers. There are 232 acres within a ½-mile radius of 7 of the 8 sites.

"However, it is largely unknown how spotted owls respond to fire and there may be some potential for adverse impacts to spotted owls due to disturbance or effects to spotted owls potentially using these burned areas or areas immediately adjacent to the burned areas" (USDI, USFWS 2003, 66). Burned areas of less than 10 acres would not be salvaged. No green trees would be intentionally felled except for operational needs, such as OSHA safety hazards or logging tailholds.

The issue of the value of a burned stand of over 10 acres in size to an owl is further discussed in the BO (USDI, USFWS

2003, 66, 67). The presumption is that a burned stand no longer provides NRF habitat. Whether a burned stand is harvested or not does not impact the timetable for returning the area to LSOG character.

For the research units, plus the area salvage units, 307 acres of burned timber would be entered within a ½-mile radius of 11 owl sites that remained active in 2003. Another 341 acres would be treated within the ½-mile radius of 8 sites vacant in 2003. Only two of those eight were active in any of the five years preceding the fire. An additional 326 acres would be salvaged outside the ½-mile radius of the historic owl activity centers.

Impacts of roadside hazard removal would be low in terms of modifying habitat near owl activity centers. No roadside salvage is planned within the ¼-mile radius of any active owl centers. If any danger trees were to be felled, they would remain on site. There are 33 acres proposed for treatment with ¼-mile radius of 5 historic sites, and 400 acres within a ½-mile radius of 16 sites.

Restoration

Direct and Indirect Effects

Effects from ridgeline FMZs would be the same as in Alternatives B, C, and D, as previously discussed in Effects Common to All Alternatives. With only material smaller than 8" DBH to be removed, canopy closure in the 400 to 600 foot-wide ridgeline strips would be negligibly altered. The FMZs are intended to be maintained in the open understory condition indefinitely via retreatments as needed. Owl foraging habitat would be degraded, but would remain foraging. FMZs would contribute to patchiness that benefits owl productivity (Franklin, et al. 2003, 579 and 580). There are no known spotted owl nests on ridgelines on Medford District BLM, so the FMZs would not affect owl nesting habitat. The objective for the FMZ project is to maintain more NRF habitat long-term by minimizing the spread of future stand-replacement fire.

Effects from young stand thinning would be the same as for Alternatives C and D. Impacts to owl foraging would be negligible. Seasonal restrictions to reduce noise disturbance would be employed for treatment of units within a ¼-mile radius of active sites. Effects from thinning mid-seral stands and pine release would be the same as for Alternatives C and D, except no units would be within ¼-mile of occupied activity centers. Trees up to 24" DBH could be removed in the pine restoration thinning. Most of the pine restoration would take place on hotter, drier, south aspect slopes that are currently lower quality foraging habitat. There would be short-term disruption to prey species and foraging quality for up to several years. The long-term benefit would be hastened growth of larger trees to promote LSOG character.

Cumulative Effects

In the research portion of the alternative, fire-killed timber would be removed within ¼-mile of the activity center of 3 sites predicted to remain active (Timbered Rock, Alco Rock, and Alco Rock West). The role of these stands in augmenting habitat for the returning owls is unknown, so there is an unquantified risk to continued owl occupancy and future productivity. Other impacts were discussed in the previous section on effects common to all alternatives. For Section 7 ESA consultation purposes, the Preferred Alternative would be a "May Affect, Likely to Adversely Affect." The Biological Opinion (USDI, USFWS 2003, 105) contains the Incidental Take statement for all the projects in SW Oregon for FY 2004-2008.

In terms of impacts to spotted owl Critical Habitat and the ability of the LSR/CHU to function as a part of the range-wide network of CHUs, the B.O. states "While there will be adverse effects to this CHU in the form of NRF loss or downgrading, the Service does not believe that the proposed action will preclude the ability of this CHU to function as intended" (USDI, USFWS 2003, 77).

Northern goshawk

Goshawks are habitat generalists using a variety of forest types, forest ages, structural conditions, and successional stages (Reynolds, et al. 1992, 1). They have home ranges of approximately 6,000 acres. The nest area (approximately 30-40 acres) is typically located in a late-successional forest stand. Goshawks construct nests in green trees. They do not use dead trees for nesting.

Six goshawk survey routes did not detect any goshawks in the fire area in 2003. BLM-administered land in the Elk Creek Watershed could provide home ranges for two or three pair of goshawk.

Goshawk surveys are not required by BLM. However, goshawk is a Bureau Sensitive species. Surveys would be done only if a restoration project that would remove suitable habitat would occur during the nesting period in green stands. The nesting period is March 1 through July 15. Projects after the nesting period would not adversely affect nesting goshawk. After the young fledge, they can fly and move away from a disturbance. Restoration projects in the understory do not remove suitable goshawk habitat and are expected to improve stand conditions for flight. In BFRA, goshawks have nested in two stands the year following a thinning project.

Great Gray Owl

Great gray owls use many of the same forests as spotted owls and goshawk. They also can be found in oak woodlands and open conifer stands, adjacent to meadows and openings.

Great gray owls are a NFP Survey and Manage species. Areas burned with high and moderate severity are not considered to be nesting habitat, although they may forage there. One criterion for triggering surveys is the action would occur in mature stands 80+ years old with greater than 60 percent canopy cover.

Surveys would be completed prior to implementation of any projects proposed in green stands within suitable great gray owl habitat. If great gray owls are detected, buffers would be applied as listed in project PDFs. If thinning projects were scheduled to occur outside the seasonal restriction (March 1-July 15), surveys would not be necessary. Thinning projects would not remove suitable habitat.

Fisher

Fisher surveys have not been completed within the Elk Creek Watershed on BLM-administered land. There are no data to indicate how many fishers are present in the watershed. Fishers are known to travel over large areas. One fisher was located in the Bitter Lick drainage on USFS Prospect Ranger District lands within the Elk Creek Watershed.

The home range size during the non-breeding season is approximately 25 km^2 for females and approximately 62 km^2 for males (Raley and Aubrey 2002, 7). The Elk Creek Watershed could include one or more home ranges.

Red Tree Vole

Red tree vole surveys were completed for the proposed FMZs in green stands in 2003. Sixty four confirmed red tree vole nests were found, mostly in the northern part of the burned area. Habitat areas will be established around active nests and the areas will be protected according to the current management regulations. Surveys would be completed in red tree vole habitat following current interagency protocol prior to any action that would remove habitat. Any red tree vole nests found would be protected according to *Management Recommendations for the Oregon Red Tree Vole Arborimus longicaudus*, version 2.0, or the most current guidelines.

Terrestrial mollusks

Two Survey and Manage mollusk species (*Monadenia chaceana* and *Pristiloma arcticum crateris*) are on the Butte Falls Resource Area list of species requiring surveys prior to habitat-disturbing activities. One species is found in wet areas in late-successional forests. The second is associated with rock and duff in late-successional forests.

Neither mollusk species was found in surveys completed in the adjacent Trail Creek and Lost Creek watersheds. The chance of finding them in the project area is very low.

Areas with high and moderate burn severity would not provide late-successional habitat for the Survey and Manage mollusks. These stands do not meet habitat conditions needed for the mollusk species which require moist late-successional forest. Pre-disturbance surveys would not be required in these stands. Newly created snags would not provide habitat for these species.

Surveys would be completed according to current interagency protocol prior to habitat-disturbing restoration or road construction activities in late-successional green forest stands. Any mollusk site would be protected with a buffer according to the latest interagency management guidelines.

Surveys would be completed for survey and manage mollusks before implementing habitat altering actions in late-successional forests. Buffers would be applied if any sites were found, following current management guidelines. No impacts to mollusks are anticipated in any alternative due to surveys and protection. Management guidelines were designed to reduce risk to the species and assure persistence of survey and manage mollusks, if they are found to be present in the watershed. Mollusks will not be discussed further.

Effects of Alternative A (No Action) on all Other Species Associated with Late-Successional Habitat

Salvage

Direct and Indirect Effects

Under Alternative A, no salvage is proposed. Only snags identified as roadside hazards would be removed. This would have no effect on species associated with late-successional habitat.

Large snags near the unburned forest edges or inside green stands could provide future nest structure for great gray owls. These owls do not build nests, but often nest in the top of large snap-top snags. None of the large snags adjacent to unburned forest edges would be removed, unless they were a roadside hazard.

Fisher would benefit from the increase in large snags. These snags would provide logs with holes from burn and rot, and piles of large wood within the green stands when they fall. This would increase habitat for hiding, denning, and resting. The snags would provide habitat for prey species and increase prey availability for great gray owls.

Restoration

Direct and Indirect Effects

Habitat restoration projects to improve development of late-successional habitat characteristics would not be implemented. This would result in slower development of late-successional and old-growth characteristics in younger forest stands.

Cumulative Effects

The Timbered Rock Fire caused a negative effect on great gray owl through loss of habitat.

There would be no change in current management in the watershed.

No increase in cumulative effects would occur under Alternative A.

Effects of Alternative B on all Other Species Associated with Late-Successional Habitat

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur. Effects would be the same as Alternative A.

Restoration

Direct and Indirect Effects

Activities such as thinning, fireline construction, or fire in the understory would provide a short-term disturbance (the time of the action). If goshawk, great gray owls, or fisher were present, they would move away from the area during the time of the action.

Restoration projects would slightly decrease fisher habitat suitability in the FMZs by opening the understory in some stands. Thinning and underburning the understory would reduce hiding cover. FMZs would occur along the ridgelines and are designed to help control the spread of a wildfire. It might prevent the loss of large areas of habitat such as occurred with the Timbered Rock Fire.

FMZs would be 200-600 feet wide. Understory conifers and hardwoods would be removed and canopy reduced to no less than 40 percent. Fisher could move through the areas to access forest on either side. No information is available to determine if short-term disturbance would cause fisher to move permanently out of the area, or temporarily relocate and move back when the activity is complete.

Overall, impacts of restoration activities to fisher would be expected to be negligible.

A project to pile logs in areas with high burn severity to provide fisher and other mammal denning and hiding areas would not be developed.

Thinning activities that occur outside the nesting period after the young have fledged would not affect nesting goshawk or great gray owls. Goshawk, great gray owl, and fisher would benefit in the long-term (30+ years) from activities designed to promote late-successional forest habitat.

Thinning to create future eagle nest habitat would open the stand to 40-60 percent canopy along the edges of the meadows. This would mimic historic conditions when wildfire maintained the meadows and open pine/conifer stands. Both goshawk and great gray owl would benefit, as they both use open stands with large conifer overstory for hunting and nesting.

Open understory and canopy facilitates flight and prey capture for both goshawk and great gray owl. Dense brush and conifer thickets in the understory reduce the ability of great gray owls to hunt small mammals on the forest floor.

Pine restoration on 156 acres would remove some of the Douglas-fir to promote the restoration of pine stands in the watershed. Great gray owls and goshawk are associated with open pine stands in other parts of their range. This would improve habitat for them.

Impacts from restoration activities to goshawk and great gray owls would be negligible.

Pine is not red tree vole preferred forage. There would be some reduction of suitable habitat in stands where pine restoration is proposed by removal of some Douglas-fir and white fir. Stands that are predominantly pine do not provide optimal red tree vole habitat. Surveys would be completed in suitable red tree vole habitat prior to restoration projects. Active red tree vole nests would be protected with a minimum 10-acre buffer or according to current management guidelines. Management guidelines were designed to reduce risk to the species and assure persistence of red tree voles in the watershed.

Impacts to red tree voles from restoration activities would be negligible. Protecting known active sites under current management recommendations would assure the persistence of red tree voles in the Elk Creek Watershed.

Cumulative Effects

Timbered Rock Fire created large patches of early seral forest in high and moderate burn severity areas. This increased fragmentation of late-successional forests in the watershed.

No adverse cumulative effects would result from restoration activities. Managing the watershed primarily for late-successional forest conditions would be beneficial to late-successional species in the long-term.

Salvage operations are occurring on industrial forest lands within the Elk Creek Watershed. Industrial forest land does not contribute to late-successional habitat in the watershed. The stands are managed for maximum timber production and generally harvested before they reach 80 years old.

Cumulative effects from activities on private lands would be the same for all alternatives.

Effects of Alternative C on all Other Species Associated with Late-Successional Habitat

Salvage

Direct and Indirect Effects

Salvage on 247 acres would remove 10-20 percent of the snags in high and moderate burn severity areas exceeding 10 acres with less than 40 percent canopy. Roadside hazard salvage on 1,078 acres would remove hazard trees near the roads.

Salvage of roadside hazard trees would not affect goshawks, great gray owls, fisher, or red tree voles. These hazard trees would be felled to protect public safety. They do not provide habitat for late-successional species.

Specific guidelines developed in the South Cascade LSRA for snag levels in LSR 224 (Elk Creek) would occur on no more than 20 percent of the acres with above the number of leave trees for large wood recommended in the LSRA (USDA and USDI 1998, 94-95).

Salvage would leave 95 percent of the snags in the salvage areas. Ninety percent of the stand-replacement acres would not be entered (see Table 2-2). Snags would not be salvaged in stands less than ten acres with greater than 40 percent canopy.

Snags within these stands would provide future nesting habitat for great gray owls. Great gray owls use mature forests or younger forests with remnant older trees or snags. Due to the high number of snags left, impacts would be negligible.

Disturbance from noise and human presence during salvage would occur if goshawk, great gray owl, or fisher were nearby, but it would be short-term.

Effects to the prey species for goshawk, great gray owl, and fisher from salvage are expected to be negligible due to the high number of snags left on site.

Alternative C provides a conservative approach to salvage. A substantial portion of dead trees would be left in place to provide habitat needs from early through mid-seral and into late seral stages. A review of the research on decay rates of snags and down wood suggests much of the material 16 inches or greater in diameter would remain on site until the next forest stand could begin to input this size of material again (USDA and USDI 1998, 169).

Under Alternative C, salvage would have a negligible impact to species using late-successional habitat.

Restoration

Direct and Indirect Effects

Effects under Alternative C would be the same as those in Alternative B. However, there is a difference in scale. Approximately 500 additional acres of meadow and oak woodland would be treated improving foraging opportunities for great gray owls.

Piles of logs would be established at six sites to provide denning, hiding, and resting cover for fisher and other mammals in areas with high burn severity. Wildlife would benefit from the increased availability of larger log piles in high burn severity areas. Effects would be the same in Alternatives D, E, F, and G.

FMZs between Trail Creek and Lost Creek watersheds would reduce canopy cover in areas along the ridges and could reduce suitability for red tree voles. However, the canopy in these areas would remain at approximately 40 percent.

The FMZs are designed to create areas where protection of remaining late-successional and old-growth habitat could occur in the event of future wildfires. There would be some loss of fully suitable red tree vole habitat within the FMZs.

Cumulative Effects

The loss of habitat from the Timbered Rock Fire caused negative impacts to late-successional species. Under Alternative C, salvage and restoration projects would not create additional fragmentation of the green tree stands in the watershed.

Salvage operations cutting only fire-killed trees would not alter late-successional or old-growth habitat. Based on habitat assessment numbers used for Northern spotted owl habitat types 1, 2, 7, and 8, 10,400 acres of late-successional habitat remains in the Elk Creek Watershed post-fire. The proposed actions would not decrease the ability of goshawks, great gray owls, or fishers to migrate between 5th field watersheds.

Future planned timber harvest on Federal lands in adjoining watersheds would remove late-successional habitat. These proposed sales were surveyed for great gray owls, goshawks, and red tree voles prior to the proposed actions. Known sites will be protected with an appropriate buffer.

Approximately 2,000 acres of late-successional habitat remain in the Trail Creek Watershed and approximately

5,600 acres will remain in the Lost Creek Watershed after the proposed actions. Figures are based on spotted owl nesting and dispersal habitat ratings. Actual acres used by goshawk and great gray owl would be higher because they are more habitat generalists and may use more open habitat than spotted owls.

Late-successional habitat remaining in the adjacent 5th field watersheds after the actions would provide nesting, foraging, and dispersal for goshawk, great gray owl, and denning and dispersal for fisher.

Proposed actions would not lead to the need to list goshawk, great gray owl, or fisher as Threatened or Endangered.

Red tree voles were rated as highly vulnerable to local extermination from habitat fragmentation or loss and are recognized as closely associated with old-growth forest habitat. Significant declines in tree vole populations are expected from major reductions on old-growth Douglas-fir habitat (USDA and USDI 2000, 5). Red tree vole populations were reduced by the fire, but the remaining unburned late-successional habitat would allow the areas to repopulate as the forest recovers from the fire.

FMZs would mainly occur in the southern part of the watershed, where red tree voles are not likely to be present. Dispersal habitat in the north part of the watershed would remain mostly intact except in Section 1 where an FMZ would connect with USFS lands.

Thinning would improve late-successional habitat development. The actions proposed in this alternative would not affect red tree vole population persistence.

Effects of Alternative D on all Other Species Associated with Late-Successional Habitat

Salvage

Direct and Indirect Effects

Salvage of 820 acres of high and moderate burn severity is proposed in areas greater than 10 acres with less than 40 percent canopy. Roadside hazard salvage would occur on 1,064 acres. Eighty-eight percent of fire-killed trees equal to or greater than 8" would remain after the proposed action (see Table 2-2).

Salvage operations would leave dead tree numbers according to DecAID Wood Advisor recommendations. Snag and additional tree levels would be retained to mimic natural conditions. “Some areas of the landscape will likely provide low snag densities, but maintenance of high-density clumps across landscape is supported by the wildlife data and by inventory data from unharvested plots” (DecAID 4). A memo from REO states that using the DecAID Wood Advisor tool to determine retention snag numbers would be consistent with objectives for managing LSRs (see Appendix A).

Salvage would remove fire-killed trees and would only occur in the stands greater than 10 acres with high and moderate burn severity and with less than 40 percent canopy. Salvage would have no effect on red tree voles since dead trees do not provide habitat. Short-term disturbance to goshawk, great gray owls and fisher could occur if they are present nearby.

Great gray owls would use broken top snags adjacent to suitable green tree stands for nesting. The total amount of snags available would be reduced. Snag retention levels would leave many snags to provide nesting platforms if the tops snap off.

The effects to great gray owls would be negligible.

All snags within stands with greater than 40 percent green canopy would be left for future nesting habitat. Snags which are a road hazard would be removed in green stands.

The proposed action would have negligible impacts to goshawk, great gray owl, and fisher.

Restoration

Direct and Indirect

Although there would be a slight difference in scale, effects of proposed restoration activities under Alternative D would be the same as Alternative B.

Cumulative Effects

Under Alternative D, cumulative effects would be the same as Alternative B.

Effects of Alternative E on Species Associated with Late-Successional Habitat

Salvage

Direct and Indirect

Salvage on 3,269 acres of BLM-administered land is proposed. Roadside salvage would remove hazard trees on 536 acres. Salvage of dead trees is proposed in all levels of burn severity throughout the burn area, including green stands.

Coarse wood levels would meet Matrix requirements (120 linear feet, 16 feet by 16 inches). This meets minimum amounts in the NFP ROD for Matrix lands and meets or exceeds Matrix recommendations for Douglas-fir and white fir forests in *Guidelines for Snag and Down Wood Prescriptions in Southwestern Oregon* (White 2001).

Coarse wood levels would be less than the amount recommended in the South Cascades LSRA and DecAID. No

studies were found to indicate what level of coarse wood was optimal for species using coarse wood in late-successional habitat.

Effects of salvage in high and moderate burn severity areas greater than 10 acres would be similar to Alternative C and D. Impacts of salvage in green stands would differ.

Alternative E proposes salvage in all burned green stands. The NFP ROD addresses the importance of small patches created by disturbance within LSR. "Potential benefit to species associated with late-successional forest conditions is greatest when stand-replacing events are involved. Salvage in disturbed sites of less than ten acres is not appropriate because small forest openings are an important component of old-growth forests. In addition, salvage should only occur in stands where disturbance has reduced canopy closure to less than 40 percent, because stands with more closure are likely to provide some value for species associated with these forests." (USDA and USDI 1994b, C-14).

If left in place, the snag patches in green forest stands would ultimately lead to the creation of small gaps with patches of coarse wood. This is characteristic of the transition and shifting-gap stages of old-growth forest.

Late-successional habitat with low burn severity in the understory is currently potential goshawk and great gray owl nesting habitat. The fire improved conditions in the understory by removing brush and understory trees, facilitating flight and hunting opportunities.

Large snags within a green stand provide important nesting, denning, feeding, and roosting sites for several species of prey utilized by goshawk, great gray owls, or fisher. Snags are used extensively by cavity-nesting birds and mammals, such as woodpeckers, nuthatches, chickadees, and flying squirrels.

Alternative E would have the greatest impact to developing late-successional habitat within the Elk Creek Watershed. Removing snags within the green stands would result in lower quality late-successional habitat for species depending upon this habitat. "Salvage of dead trees affects the development of future stands and habitat quality for a number of organisms" (USDA and USDI 1994b, B-8).

Removal of dead trees within the green stands would reduce the number of leaning and down trees in the understory. Down logs provide goshawk plucking posts, as well as cover, feeding, and nest sites for several mammal and bird prey species.

The green islands with low burn severity understory are currently potential great gray owl habitat. Young great gray owls leave the nest before they can fly. They need leaning trees and down wood to climb up off the forest floor out of the reach of predators. In the long-term, removal of excess snags within the green patches reduces the amount of coarse wood and leaning trees available to young owls on the forest floor. Potential nest trees within the green stand would also be reduced.

Surveys would be completed before any projects are undertaken. If the project occurs outside the seasonal restriction, then surveys are not necessary. A seasonal restriction would be in effect for any actions within the green stands if they have not been surveyed for goshawks and great gray owls.

In mid-seral stands, snag removal may result in long-term influences on forest stands. Large snags would not be produced in natural stands until trees become large and begin to die from natural mortality.

Within the green stands suitable for fisher, Alternative E would reduce forest structures used by fisher for natal and maternity dens, hiding and resting sites, and foraging areas. Fisher use snags with defects, cavities, and holes provided by primary cavity excavators for natal sites, denning, and resting. They often use hollow logs on the forest floor for maternity dens, hiding cover, and foraging sites.

Four snags per acre would be left within the green stands. This would provide snags for habitat and future coarse wood, but would reduce the total numbers available where snag numbers were higher than four per acre. Activities within the stands could directly affect natal sites and maternity dens.

Salvage in green stands with canopy less than 40 percent could cause local, short-term disturbance from noise and human presence while the action is occurring. Fisher are not likely to use these areas for natal or maternity sites, but may use the areas for resting or foraging.

Salvage within green stands would reduce the overall suitability of habitat for late-successional species (including small mammals, invertebrates, lichens, and fungi). This may also reduce the amount of time for some green stands to attain or return to optimal late-successional habitat.

The impact to late-successional species, goshawk, great gray owls, and fisher would be low to moderate.

Alternative E would have an adverse effect on late-successional habitat in the green stands. The impact would be slower development of optimal habitat for late-successional dependent species and a reduction in habitat structure available within the green stands.

Surveys for red tree voles would be completed in suitable habitat within the green stands prior to beginning the action. Dead trees are not red tree vole habitat, but falling trees could hit a nest.

The effects of salvage to red tree voles would be negligible because surveys would be completed and nests would be protected within a buffer.

Restoration

Direct and Indirect

Effects from proposed restoration projects under Alternative E would be the same as Alternative B, although there would be some difference in scale.

Cumulative Effects

The Timbered Rock Fire caused an adverse impact to late-successional species from a loss of habitat. The proposed actions under Alternative E would not increase fragmentation of late-successional forests, although the action would remove some snag components within the late-successional green stand. This could reduce the suitability of the green stands a slight amount. Four snags per acre would be left in the green stands, so the effect to wildlife within the green stands would be low to moderate.

Timber sales on Matrix lands in adjacent watersheds would maintain Riparian Reserves (although some restoration would occur) and late-successional habitat.

Late-successional habitat remaining in the adjacent 5th field watersheds after the proposed actions would provide nesting, foraging, and dispersal for goshawk and great gray owl, and denning and dispersal for fisher. Approximately 2,000 acres of late-successional habitat in Trail Creek and 5,600 acres in Lost Creek Watershed would be present after the future actions. Approximately 10,400 acres of late-successional habitat remains (post-fire) in the Elk Creek Watershed. These figures are based on Northern spotted owl habitat rating.

FMZs on 1,300 acres would reduce the canopy, but the stands would still have 40 percent canopy and the larger overstory trees would remain. Goshawk, fisher, and great gray owls could still use the FMZs to migrate between 5th field watersheds. Goshawk nests in adjacent watersheds are protected with a 30-acre buffer, and cumulative actions by BLM and USFS would not diminish connectivity.

The proposed action would not lead to the need to list goshawk, great gray owl, or fisher as Threatened or Endangered.

Effects of Alternative F on all Other Species Associated with Late-Successional Habitat

Salvage

Direct and Indirect Effects

Under Alternative F, salvage is proposed on 213 acres. Salvage would only occur in green areas within 2- to 10-acre pockets of dead trees. Roadside hazard salvage would occur on 1,182 acres.

Two acres within each patch of fire-killed snags in the green stands would be left untreated. This would leave patches of snags where small-scale disturbances could create small gaps in the overstory characteristic of the shifting-gap stages of old-growth stands. The small gaps are an important component of the development of late-successional and old-growth habitat.

Coarse wood, snags, and leaning trees would be present in the 2-acre unsalvaged pockets at natural levels. This would benefit species which depend on the coarse wood (small birds, mammals, reptiles, and amphibians, and the invertebrates, fungi and lichens they feed on).

Goshawks use the leaning trees and coarse wood for plucking posts. Great gray owl young are able to climb off the forest floor using these structures. Fishers also use these structures for natal and maternity dens, hiding and resting sites, and foraging areas.

Removing all snags in the 2 to 10-acre patches would have a low impact on the late-successional species because these structures would be provided in the 2-acre patches adjacent to the salvage areas and in all burned areas greater than 10 acres.

There would be an anticipated slower development of optimal late-successional habitat. The impact would be much less than Alternative E, as proposed salvage would only occur in the 2 to 10-acre stands.

As in Alternative E, in mid-seral stands with low or very low burn severity, snag removal may result in long-term influences on forest stands. Large snags would not be produced until trees become large and begin to die from natural mortality. The 2-acre patches would provide some of the large snag and future coarse wood structure in these stands.

Snags would not be removed in the adjoining high and moderate burn severity areas. Voles, pocket gopher, and other prey species would be at 100 percent level in the high to moderate severity burn areas. Great gray owls forage in open areas. Snags left in these areas would remain for hunting and roosting perches.

Habitat for woodpeckers, jays and other prey species in the high and moderate burn severity areas would be at the 100 percent level. These species may be utilized by goshawk, great gray owls, and fishers foraging at the edges of the burns.

Impacts to red tree voles would be the same as Alternative E in the 2 to 10-acre patches with less than 40 percent canopy.

Impacts to goshawk, great gray owl, and fisher would be low. Impacts to development of late-successional habitat would

also be low because 2-acre patches would be left within the stands.

Restoration

Direct and Indirect Effects

No restoration would occur in early seral conifer and pine stands to promote the development of late-successional habitat and the development of ponderosa/sugar pine stands. Riparian habitat enhancement projects would not occur. Current growth rates would continue.

Eagle nesting habitat improvement would benefit goshawk and great gray owls by opening the understory which facilitates flight and increases hunting opportunities.

Half the acres of FMZs proposed in the other action alternatives would be treated under Alternative F. As a result, overall impacts would be lower because fewer acres would be treated. The effects would be the same where FMZs were created.

Cumulative Effects

Alternative F would slightly reduce the quality of future late-successional habitat for prey species in some green stands by removing 2- to 10-acre pockets of snags. However, connectivity of goshawk, great gray owl, and fisher populations between 5th field watersheds would remain.

Approximately 10,400 acres of late-successional habitat would be available in the watershed. Timber sales planned on BLM-administered land in the Lost Creek and Trail Creek watersheds would remove late-successional habitat on Matrix lands.

Late-successional habitat remaining in the watersheds after future actions is adequate to provide nesting, foraging, and dispersal for goshawk, great gray owl, and denning and dispersal for fisher (see discussion in Alternative C).

None of the proposed actions in Alternative F would lead to the listing of fisher, great gray owl, or goshawk as Threatened or Endangered. Alternative F would not reduce persistence of red tree vole populations.

Effects of Alternative G (Preferred Alternative) on all Other Species Associated with Late-Successional Habitat

Salvage

Direct and Indirect Effects

Under Alternative G, salvage is proposed on 282 acres within research units and approximately 961 acres in high and moderate burn severity areas greater than 10 acres with canopy less than 40 percent. Roadside hazard salvage would occur on approximately 1,188 acres. About 70 acres of roadside hazard salvage would be small patches of fire killed trees on very steep slopes above the road that would be intensively salvaged. Other roadside hazard would remove scattered snags that are leaning toward the road or have exposed roots or other structures that are a hazard to people traveling on the roads. The impacts from roadside hazard salvage on species associated with late-successional habitat would be negligible.

Except for removal of hazard trees as discussed above, low and very low burn severity areas would not be salvaged. The impacts to species that use late-successional habitat would be negligible. Areas that burned with high and moderate intensity are no longer late-successional habitat.

The unsalvaged snag patches in green forest stands would ultimately lead to the creation of small gaps with patches of coarse wood. This is characteristic of the transition and shifting-gap stages of old-growth forest. The low and very low burn severity areas would provide a continuous supply of coarse wood as the stands continue to develop. Protecting these areas from salvage would retain 100 percent of the large-diameter snags and logs provides habitat for species that use these features. The low underburn opened the understory and removed much of the smaller brush and trees. As a result, these stands would develop late-successional and old-growth characteristics sooner than densely crowded forests. The proposal not to salvage within these areas would leave snags and CWD to provide hiding, nesting, roosting and foraging structures for wildlife.

Approximately 8,000 acres of low or very low underburn are present inside the fire perimeter to provide snags and CWD. These areas as well as the high severity burn areas less than 10 acres and snag retention areas set aside to meet snag requirements in salvage areas would provide large snags and large CWD for refugia. These structures are expected to remain in the forest for decades. Whether these would remain on the landscape or burn up during subsequent fires cannot be determined, as many variables influence fire behavior.

The impacts in the high and moderate burn severity areas greater than 10 acres would be the same as Alternative C and D, except fewer snags would be left to provide habitat for prey species. See graph Figure 2.3-2 for numbers of leave trees determined from stand exam data. The information shows that approximately 76 percent of snags greater than 20" would be left under Alternative G.

Between 8 and 12 snags per acre would be left in salvage areas. Smaller trees with no commercial value would not be removed, except as needed for operational safety. This meets DecAID recommendations.

The NFP ROD recommends broad-based dead wood levels. Because ecological processes vary in different ecosystems

of the Northwest, the development of more site-specific recommendations were proposed in the ROD.

The Southwest Oregon Provincial Interagency Executive Committee (PIEC) requested a province-wide process be developed for determining levels of snags and down woody material in southwestern Oregon forests. The result was a paper, *Guidelines for Snag and Down Wood Prescriptions in Southwestern Oregon* (White 2001). This paper had the support of the PIEC and had several reviews and revisions from many resource specialists. It is based on the current state of the science in southwestern Oregon. The paper made recommendations for snag and coarse wood levels in southwestern Oregon based on plant series. A comparison of recommended snag and CWD levels by different sources was done (see Appendix D, Table D-5). Snag and CWD levels under Alternative G would be within DecAID Wood Advisor ranges.

The snag and coarse wood retention levels proposed in Alternative G would exceed the levels of coarse wood and snags recommended in the White paper except in one of the research treatment areas on 147 acres, where six tpa would be left.

Impacts to goshawks and great gray owls of proposed salvage in the high and moderate burn severity areas greater than 10 acres and/or less than 40 percent canopy would be negligible. Perching posts, nesting sites and prey habitat would be provided by the 8-12 snags per acre left on site. All snags would be left in areas less than 10 acres or with greater than 40 percent canopy.

Fisher would not be affected by salvage in areas greater than 10 acres because they typically do not use large openings.

Dead trees are not red tree vole habitat. Salvage under this alternative would have negligible effect on red tree voles.

Under Alternative G, salvage in scientific research units would occur on 282 acres. Research would look at different levels of snag retention and the effect to wildlife (see Appendix G for a description of the proposal).

Three replications would be implemented for each research treatment. This includes 186 acres of control plots where no actions would occur. There would be no impact to late-successional species in the control units. Salvage in 4 plots (147 acres) would leave 6 snags per acre. In 4 plots (192 acres), 30 percent of the site would be unsalvaged.

The proposed research units would be outside the green stands in the high to moderate burn severity areas only. Late-successional habitat would not be effected by these research treatments.

The fire-killed snags in the high and moderate burn intensity stands do not provide habitat for red tree voles. Scientific research units would have negligible effect on red tree voles.

Removal of snags in the stands with less than 40 percent canopy with high to moderate burn severity would have a negligible effect on fisher, goshawk, and great gray owl.

The study is designed to determine the relative influence of three treatments on wildlife species. Information about the impacts of different levels of salvage on bird and small mammal populations in southwestern Oregon is lacking. Cavity nester studies have been conducted elsewhere in the Pacific Northwest, but not within the Oregon Western Cascade Province of southern Oregon.

Data collected from this study would be used to test assumptions about the appropriate level of snag retention during salvage operations in southern Oregon ecosystems. Results would be used to make management decisions regarding snag retention levels in future operations.

Restoration

Direct and Indirect Effects

Effects from proposed restoration projects under Alternative G would be the same as Alternative B.

Cumulative Effects

Although the scale is different, the cumulative effects from Alternative G would be the same as Alternative C. The number of additional acres in FMZs and reforestation would not change the cumulative effects.

Areas of connectivity (contiguous green stands) between the watersheds would still be present and the cumulative effects of the Trail Creek and Lost Creek timber sales would not reduce the persistence of the species.

3.12.3.2 Cavity and Down Wood Dependent Species

Snags are important for many species of wildlife including woodpeckers, flammulated owls, bluebirds, flying squirrels, bats, and clouded salamanders. Many of these species use holes excavated by woodpeckers or created by rot, broken tops, or broken out limbs.
Dead wood on the ground is an essential habitat component for many birds, small mammals, and some large mammals, including bears. Large logs harbor many invertebrates and also provide shelter and cover for amphibians and mammals (Lyon, et al. 2000, 7). Down wood provides substrate for lichens and fungi which are important in the diet of many wildlife species.

Effects of Alternative A (No Action) on Cavity and Down Wood Dependent Species

Salvage

Direct and Indirect Effects

Under Alternative A, no salvage would occur. There would be no reduction in dead trees in the watershed, except for roadside hazard trees. The removal of hazard trees would occur in scattered areas where human safety would be at risk. The effect to cavity and coarse wood dependent species would be negligible.

Habitat for primary and secondary cavity users would be abundant, in the short-term (1 to 10 years or more). Future soft snags and coarse wood would also be abundant as the burned trees rot and fall to the ground. There would be a pulse of coarse wood in the next one to three decades. Charring and case-hardening of wood surfaces by fire can retard decay processes (Johnson and O'Neil 2001, 594) and make it difficult to determine the rate of fall and decay.

More snags would be available than would be used by cavity-excavating animals, but 100 percent of the trees would be available for the birds to use.

Snag patches within green stands provide valuable habitat for several species of woodpeckers and cavity dependent species. Pileated woodpeckers use large snags inside the green stands for nesting. Vaux's swift also use the cavities in dead trees located within the green stands. Although these birds are on sensitive species lists for other parts of Oregon, they are not on the Medford District BLM sensitive species list.

Restoration

Direct and Indirect Effects

There would be no change in current management practices under Alternative A.

Cumulative Effects

The Timbered Rock Fire resulted in a large increase in the amount of suitable habitat for primary cavity excavators and future habitat available for secondary cavity nesters and coarse wood dependent species.

Salvage operations are occurring on industrial forest lands, and will likely be completed within two years. Industrial forest lands within the 5th field watershed will generally leave an average of two snags per acre. This will provide a small amount of habitat for cavity and coarse wood species on private lands.

Some woodpecker species, such as black-backed woodpeckers, are drawn to newly-burned forests because of the increase in insect populations immediately after a fire. Black-backed woodpeckers have not been found in the Butte Falls Resource Area. They have been documented west of Crater Lake National Park and could be drawn to the burned timber. Bird surveys completed in the watershed in 2003 did not detect black-backed, white-headed, or Lewis' woodpeckers (see Appendix N, Wildlife).

Proposed timber harvest in the adjacent Lost Creek and Trail Creek watersheds would not affect the ability of these species to move through the area and into the Elk Creek Watershed.

In the next one to five years, there would be an expected increase in woodpecker productivity in the watershed due to the presence of snags and the accompanying increase in insect populations.

Effects of Alternative B on Cavity and Down Wood Dependent Species

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur. Effects would be the same as Alternative A.

Restoration

Direct and Indirect Effects

Proposed restoration projects would have no anticipated effects on cavity and down wood dependent species. Treatments in 1,003 acres of oak woodlands would remove small oaks with the goal of growing large oaks to provide cavities and hollow logs in the future. This would benefit species using cavities, such as bats and bluebirds.

Pine restoration on 156 acres would benefit flammulated owl, a species on the USFWS Birds of Conservation Concern 2002 list (*Federal Register* Vol. 68, No. 25, 6179). Flammulated owls are small owls rarely seen in the Medford District BLM. These small owls are secondary cavity nesters that often use pileated woodpecker cavities in large pine and Douglas-fir trees. They are closely associated with open pine forests in other parts of their range.

Flammulated owls have not been found in Elk Creek Watershed. They were seen near the eastern watershed boundary near Burnt Peak. They are secretive, rarely sighted birds.

FMZ treatments in 1,300 acres would result in the creation of some new snags. Coarse wood on the forest floor would be at risk from underburns. Prescribed fire would occur in the cool, wet season when vegetation is dry enough to carry a fire. Past experience indicates there would be some loss of down wood during the prescribed fire. Due to the mosaic pattern created by these fires, not all coarse wood would be consumed.

Overall, there would be an expected small-scale reduction in coarse wood in the FMZs. It would be scattered throughout the watershed and intact patches would remain providing connectivity.

Cumulative Effects

No salvage is planned in the LSR on lands administered by RRNF. Post-fire snag and coarse wood levels would remain at 100 percent.

Snags available for foraging and nest excavation would remain abundant throughout Elk Creek Watershed. The timber sales in adjacent watersheds would maintain the snag levels and coarse wood amounts recommended for Matrix lands in the NFP and Medford District RMP.

Some snags would be left in the upper 1/3 of the slopes to provide bat habitat. Habitat for dispersal of woodpeckers, bats, and other species using cavities would be present throughout the watershed on BLM-administered land. In FMZs, two stumps per acre greater than 30" DBH would be cut at a height of 30-36" to provide future habitat for bats and salamanders.

Private timber companies operate under the Oregon Forest Practices Act which requires leaving an average of two snags per acre. Some small patches of snags are present on private lands. Generally, industrial forest lands do not provide considerable amounts of potential cavity and down wood dependent species habitat. This would apply to all alternatives.

Effects of Alternative C on Cavity and Down Wood Dependent Species

Salvage

Direct and Indirect Effects

Under Alternative C, 247 acres of dead trees would be proposed for salvage. Roadside hazard tree salvage would occur on 1,078 acres.

Roadside hazard salvage would remove leaning trees or trees with burned roots that could fall onto the road and create a potential hazard to humans. The effects of this salvage would be dispersed along the roads. Road side hazard salvage would have a very low effect on cavity and down wood dependent species.
The Timbered Rock Fire burned approximately 8000 acres of late seral forest in different intensities on BLM-administered land, leaving snags in varying amounts throughout the burn area. Salvage would occur in areas of high and moderate burn severity greater than 10 acres with less than 40 percent canopy. Salvage is limited to a maximum of 20 percent in areas where snag densities exceed the typical snag density by more than 20 percent.

Because only 20 percent of the snags above typical snag density would be removed, this approach would be conservative. Using the median tree number approach, no more than half the stand-replacement areas would be salvaged (USDA and USDI 1998b, 172-173).

A loss of habitat used by secondary cavity users and a reduction in future coarse wood in the high and moderate burn severity stands would occur. However, all snags would be left above the 20 percent density level. Habitat for cavity dependent species would remain at 100 percent of potential in the green stands and areas less than 10 acres.

The effects of salvage logging on cavity nesters and coarse wood dependent species would be negligible due to the high numbers of snags remaining in the watershed.

Restoration

Direct and Indirect Effects

Under Alternative C, the effects of proposed restoration would be the same as Alternative B. There is a slight difference in scale, but the effects would be the same.

Cumulative Effects

Snags would be left in patches and distributed across the watershed. The impact to primary cavity excavators would be negligible because of the amount of area left unsalvaged.

As snags fall to the ground, future coarse wood amounts would be high. This would benefit species depending on coarse wood.

The amounts of snags left in the 5th field Elk Creek Watershed would exceed the needs of primary cavity excavators, secondary cavity users, and coarse wood dependent species and allow them to migrate through the watershed and into adjacent 5th field watersheds.

The actions proposed in Alternative C would not reduce the viability of sensitive species, such as Lewis's woodpecker, flammulated owl, bats, and other species depending on these snags and coarse wood (see Appendix N, Wildlife, for a list of sensitive species in the Butte Falls Resource Area).

Effects of Alternative D on Cavity and Down Wood Dependent Species

Salvage

Direct and Indirect Effects

Under Alternative D, salvage would occur on 820 acres. Roadside hazard salvage would occur on 1,064 acres. The impacts from the salvage of roadside hazard trees would be the same as Alternative C.

Snag levels would meet those recommended by DecAID. During the development of the DecAID models, levels were determined to meet the needs of species that depend on snags and coarse wood in Southwest Oregon Mixed Conifer-Hardwood forests (see Appendix D for a description of DecAID).

Approximately 6 percent of the acres of mid- and late seral burned forest would be salvage logged. Effects to cavity and down wood dependent species would be very low, due to the high amount of timber left unsalvaged.

Restoration

Direct and Indirect Effects

Under Alternative D, effects from restoration projects would be the same as Alternative C.

Cumulative Effects

Under Alternative D, cumulative effects would be the same as Alternative C.

Effects of Alternative E on Cavity and Down Wood Dependent Species

Salvage

Direct and Indirect Effects

Under Alternative E, fire-killed trees would be salvaged on 3,269 acres. Roadside hazard salvage would occur on 536 acres. The impacts from roadside salvage would be spread over a large area and would be negligible to cavity and down wood dependent species.

Salvage would occur within the green stands as well as the burned areas outside green stands. Within the high burn severity stands, there would be little recruitment of large snags in the next 80-100 years until the stands recover.

Trees within the stands would continue to grow and die, producing future snags and coarse wood. Four snags per acre would be left in the green stands, but overall the pulse of dead wood from the fire would be diminished if the trees inside the stands are salvaged.

The importance of large trees, snags, and dead, down wood to birds and mammals is best described by Lyon, et al., “The snag represents perhaps the most valuable category of tree-form diversity in the forest landscape.” (Lyon, et al. 2000, 7).

As snags within the green stands fall, they add to dead wood on the ground, enhancing habitat for coarse wood dependent species, including small mammals. The snags falling to the forest floor also create small openings where shrubs and tree regeneration within the stands would occur.

Results from a study in dry forests on the east side of the Cascades following a stand replacement fire found an average of 8 snags per acre greater than 20 inches yielded the highest nesting populations of cavity nesters. There is no information about snag deterioration rates and changes in bird assemblages following stand-replacement fires and salvage logging (Haggard and Gaines 2001, 395).

Woodpeckers are important in the control of insect populations, especially beetles. Many woodpeckers, such as hairy and downy woodpeckers, are non-migratory and are the primary avian insectivores during winter. Predation on over-wintering arthropods is believed to reduce the potential of population increases the next year. Alternative E would remove the highest amount of available foraging habitat for woodpeckers.

Snag patches within green stands provide valuable habitat for several species of woodpeckers, such as pileated, hairy, and downy woodpeckers. One study that looked at the selection of fire-created snags found that Lewis’s woodpeckers may favor partially-logged landscapes. They also selected unlogged conditions for nesting habitat as well (Saab, et al. 2003). In the logged areas, moderate crown closure was an important feature of the landscape surrounding the nest.

Snags that are excavated or have broken limbs or holes are habitat for cavity nesting birds and mammals. Many of these species appear on sensitive species lists for other parts of Oregon, but are not on the Medford District BLM sensitive species list.

Alternative E would leave 8 snags per acre in the Douglas-fir series and 12 snags per acre in the white fir series in the high and moderate burn severity areas, and 4 snags per acre in the green stands. This would leave snags at varying levels to provide foraging and nesting habitat for woodpeckers and future habitat for secondary cavity nesters. Ultimately, the snags would provide coarse wood on the forest floor.

Because snags would be removed across the landscape, including inside green stands, there would overall be fewer snags and less coarse wood substrate for small mammals, insects, fungi, and lichens that are part of the food chain. Larger animals, such as black bear may use the holes in snags and down wood for hiding and hibernating. Black bear also forage for insects in down logs.

The proposed salvage under Alternative E would reduce the amount of snags available for cavity nesters on approximately 35 percent of the mid and late seral acres burned in the Timbered Rock fire.

Because of the levels of snags that would be removed, impacts to cavity and coarse wood dependent species would be moderate under Alternative E.

Restoration

Direct and Indirect Effects

Under Alternative E, effects from proposed restoration projects would be the same as Alternative B.

Cumulative Effects

USFS lands in the Elk Creek LSR would not be harvested. These lands would retain 100 percent of existing snags for cavity nesters and coarse wood dependent species in the north part of the watershed. These stands would still have foraging value for primary cavity excavators.

Timber harvest on adjacent 5th field watersheds, Trail and Lost Creek, would meet Matrix requirements. Salvage would be proposed on sixteen acres in the 2002 Wall Creek Fire area in the Trail Creek Watershed. No salvage would occur on 200 acres of BLM-administered lands in Trail Creek.

Cumulative effects would include the loss of snag and coarse wood habitat from salvage operations in all stands. Mid- and late seral forests that were burned and not salvage logged would provide habitat for cavity nesting species.

Salvage would be proposed on 3,269 acres of BLM-administered land that burned. After the proposed action, there would be 5,266 acres unsalvaged on BLM land within the Timbered Rock fire. Snag levels would remain at 100 percent on burned USFS lands within the Elk Creek watershed and on approximately 200 of the 216 BLM-administered acres burned in the adjacent Trail Creek watershed. The amount of remaining snags within the watershed would result in low cumulative effects on cavity nester populations.

While the action would remove snags within the watershed, cavity nesters could migrate between the watersheds. Alternative E would not lead to the need to list any sensitive species as Threatened or Endangered.

Effects of Alternative F on Cavity and Down Wood Dependent Species

Salvage

Direct and Indirect Effects

Under Alternative F, all dead trees in the high and moderate burn severity stands would be left. There would be no effect from salvage in the large patches of dead timber.

Within the green stands, only 2 to 10-acre patches would be salvaged. A minimum of two acres in each green pocket would be left intact. Effects within the green stands, where salvage occurred, would be the same as Alternative E. Coarse wood on the forest floor within the green stands provides habitat for foraging woodpeckers, small mammals, invertebrates, lichens, and fungi, which are a food source for many animals.

The impacts from Alternative F would be much lower than Alternative E because 2-acre patches of fire-killed snags would not be salvaged in the green stands. The impacts to cavity and down wood dependent species would be low. Snags outside the green stands not determined to be hazard trees would remain to provide large areas of snags for foraging. As snags fall to the ground and the new forest grows up around them, they would provide coarse wood.

Restoration

Direct and Indirect Effects

Under Alternative F, the effects of proposed restoration would be the same as Alternative C. There is a difference in scale, but the effects would be the same.

Cumulative Effects

High numbers of snags would be left in the high and moderate burn intensity stands. Many of these stands are adjacent to industrial forest lands which have been salvage logged. There would be 100 percent of snags available to cavity and coarse wood dependent species in these areas.

Habitat for cavity nesting birds which use snags within green stands, such as Vaux's swift and pileated woodpeckers, would have reduced capacity to provide future habitat for these species. While there would be a lowered nesting opportunity in the green stand, connectivity with adjacent watersheds would not be diminished.

Overall, Alternative F would not lead to the need to list any sensitive species as Threatened or Endangered.

Effects of Alternative G (Preferred Alternative) on Cavity and Down Wood Dependent Species

Salvage

Direct and Indirect Effects

Under Alternative G, salvage would occur on 679 acres in the high and moderate burn severity stands in snag patches greater than 10 acres. Roadside hazard salvage is proposed on approximately 1,188 acres. In the roadside salvage, about 70 roadside hazard acres would be intensely salvaged snag patches on steep hillsides above roads. Remaining roadside

hazard treatment would remove hazard trees leaning toward the road, with exposed roots, or some other defect that makes it a hazard to people traveling on the road. Removal of scattered trees in these areas would have negligible effect on cavity and coarse wood species.

Proposed area salvage would reduce the amount of snags available for cavity nesters. In a study in ponderosa pine forests in southwestern Idaho, nesting densities of cavity-nesting birds continued to increase during the first four years after a burn (Johnson and O'Neil 2001, 224). Within the high burn severity stands, it is expected that it would take 80-100 years for regeneration to begin producing large snags. Fire created snags left on-site after salvage operations would provide snags in the interim.

Several reports suggest various levels of snags are needed after a wildfire to provide habitat for birds. Haggard and Gaines (2001) found that the greatest diversity of 6 to 14 snags ≥ 25 cm (≈10") per acre provided the highest abundance, species richness, and nesting populations of cavity nesters in a study in Washington. Raphael and White (1984) reported that bird density reached a maximum at approximately 7.5 snags per hectare (≈3 snags per acre). Both recommended leaving snags in clumps rather than scattered across the landscape. Hutto (1994) also recommends salvaging trees from one part of a burn and leaving another part of the burn area untouched. Project design in Alternative G would incorporate this by leaving snags in patches (see 2.3.1.1 Area Salvage).

Raphael and White (1984) found that birds nesting in burns preferred soft snags that had generally been dead 6 years or more and probably were most valuable as nest sites 20-25 years after tree death. They estimated that 3 hard firs and 6 hard pines were necessary at year 1 to produce 1 standing soft snag in 15 years. They estimated that 12 hard snags per acre would be needed to provide 3 soft snags at year 15. This would be met under Alternative G (see Table 3.12-3).

Table 3.12-3. Estimated Snags after Salvage in Timbered Rock Fire

Size (DBH)	Snags Remaining	Snags Cut	Snags Retained per Acre
>8"	303,516	43,787	25.8
>20"	54,636	28,025	4.6
>36"	11,692	5,789	1.0

Snag and coarse wood levels would be within DecAID recommendations (See Appendix D). There would be a reduction in the amount of foraging, roosting, and nesting habitat for primary and secondary cavity users. Future coarse wood amounts would be reduced in the high and moderate burn severity areas.

Approximately 66 percent of the fire killed trees over 20" would be left. Areas of late seral forest that burned with low and very-low severity (approximately 8,000 acres) would not be salvaged. Snags in these areas would remain to provide snag habitat now and in the future. These stands would also have green trees which will die and provide snags in areas adjacent to salvage units. Large snags would be provided in the areas that are not salvaged and in the clumps that are left to meet snag requirements. As stated in Appendix D, it is anticipated that additional snags would be provided in the salvaged units because trees in the 10-16" DBH range would not be merchantable due to the delay in implementation of the salvage operations. This would provide additional snags and CWD.

Salvage of dead trees would remove foraging habitat for cavity excavators and subsequently secondary cavity nesters and eventually for coarse wood dependent species. However, effects from the proposed action would be low because of the high number of acres which are not proposed for salvage and the high number of snags left. No salvage is proposed in high and moderately burned stands less than 10 acres and areas with greater than 40 percent canopy. Low and very low/unburned stands would not be entered for salvage, providing 100 percent of existing snags and CWD. Snags that existed prior to the fire would also be left in these areas. Table 2-2, shows that 87 percent of the fire killed trees on BLM-administered land would be retained, and 63 percent of the stand-replacement acres would not be salvaged.

Scientific research by Oregon State University would provide an opportunity to study the impacts of post-fire management on avian and mammal species specific to Western Cascade Province in southwestern Oregon. The research would leave 6 snags per acre on 147 acres, and 30 percent of snags on an additional 192 acres. All snags would be left on the control plots. The study plots would be approximately 30+ acres and would be scattered around the landscape. Data from the study would be useful to land managers making management recommendations and decisions after future major fire events in the Western Cascade Province in southwestern Oregon.

Restoration

Direct and Indirect Effects

Effects of proposed restoration projects under Alternative G would be the same as Alternative C.

Cumulative Effects

USFS lands located in the Timbered Rock Fire area would not be salvaged. These would provide 100 percent of existing snags for cavity dependent and coarse wood species. These stands would provide foraging and nesting opportunities for primary cavity excavators. Timber harvest on adjacent 5th field watersheds, Trail Creek and Lost Creek, would meet matrix requirements.

BLM proposes to salvage approximately 679 acres of high intensity burn areas. Roadside hazard salvage would remove most of the dead trees on steep slopes on an additional 70 acres. Approximately 1,031 acres, 6 percent, of 11,774 acres on BLM-administered lands burned in the Timbered Rock Fire would be intensively salvaged. Nearly 10,465 acres of burned BLM land would remain unsalvaged. Snags and CWD in these lands would provide habitat for cavity and down wood dependent species. The remaining salvage of hazard trees would remove scattered snags leaning toward the road or with exposed roots. This would have a limited impact to snag densities, as all sound snags that are not hazards to the road would remain.

As stated in Appendix D, it is estimated 80 percent of the trees from 10-16" on BLM-administered lands would not be salvaged because they would no longer be merchantable due to the delay in implementation of the salvage activities. This would result in additional snags available in the salvage units.

Private timber companies have salvaged approximately 6,000 acres. ODF regulations require private operations to leave 2 snags per acres. Salvage operations on both private and Federal lands would remove snags on approximately 25 percent of the Timbered Rock Fire burned acres (27,100 acres). Snags remain in the landscape on approximately 75 percent of the total burned area, mostly on Federal land. Snags provided in the Elk Creek Watershed in the green stands and unsalvaged burned stands would provide habitat for species that use snags in green stands.

There would be a decrease in snag habitat and future coarse wood in the salvaged areas and localized areas would have few snags. Snag and cavity dependent species would need to move to unsalvaged areas for food, shelter, and refuge. CWD would be provided in the areas that were not salvaged (see Table 3.12-3).

There is no way to determine specifically how much salvage operations would impact populations in the areas where salvage occurs. In the intensive salvaged areas, CWD and snag levels would remain low for 80 or more years. However snags would be present in high concentrations in areas set aside from salvage to meet snag requirements and from high intensity burn areas less than 10 acres and/or less than 40 percent canopy on BLM-administered land. Snag levels in these areas would average 22 snags per acre over 20" DBH. Additionally, all areas on BLM-administered land with low to very low underburn will provide dead trees and future CWD. Many of these stands are adjacent to areas where salvage is proposed.

Patches of snags left to maintain snag levels would be adjacent to the proposed salvage areas and would be available for cavity nesting birds and other wildlife. These would provide CWD as the trees fall. Private timber companies left snags in clumps to meet their ODF snag leave requirements. Green stands within the 85,424 acre Elk Creek Watershed will still provide current and future snags and CWD.

Impacts are expected to be low throughout the watershed, because 87 percent of the snags would be retained on BLM-administered land (see Table 2-2) and approximately 75 percent of the burned area would not be salvage logged. Additional snags are present in older green stands in the Elk Creek Watershed outside the fire perimeter. Of 3,690 acres that burned with high and moderate severity on BLM-administered land, area salvage would occur on 961 acres, with an additional 70 acres of high intensity salvage in roadside hazard areas. Approximately 2,729 acres of high and moderate burn severity acres would not be salvaged. This would provide snags and CWD for species that use these elements.

Because of the high number of burned acres not salvaged and the proposal to leave 8-12 snags per acre in salvage units, the cumulative effects are not expected to lead to the need to list any species on the special status species list as Threatened or Endangered. There is no evidence that salvage would reduce the population viability of any of the sensitive species, or any species identified as using cavities or down wood that could be present in the watershed. Because of the increase in snags due to the fire, there would be an expected increase in some species occurring now and in the future. It would likely be a lower increase than would occur without salvage.

3.12.3.3 Other Species of Concern

Bald Eagle

Eagle populations are increasing near Lost Creek Lake. A new nest was located south of the Rogue River near Elk Creek in 1999. The Medford District RMP ROD recommends managing an area of potential nesting territory near Lost Creek Lake.

Effects of Alternative A (No Action) on Bald Eagle

Salvage

Direct and Indirect Effects

Under Alternative A, no salvage would occur. There would be no change from current management practices.

Restoration

Direct and Indirect Effects

A proposed restoration project to improve eagle nesting habitat on the ridge between Lost Creek and Elk Creek would not occur. This project would promote the development of individual trees into suitable nest trees in 10

to 30 years. Trees in these areas would continue to grow at a slower rate. Large open-grown characteristics would not develop. There would be fewer suitable nest trees available.

Other restoration projects to thin and improve the development of large trees, including pines, would not be implemented. These projects would accelerate the development of late-successional and old-growth stands. Eagles could use these stands for roosting and nesting if the stands were in a suitable location, such as near an open meadow or overlooking Elk Creek.

Cumulative Effects

Proposed actions in timber sales on BLM and USFS lands within the adjacent 5th field watersheds would not affect the ability of eagles to migrate between 5th field watersheds.

Industrial forest land does not contribute to the late-successional forest in the watershed. The stands are managed for maximum timber production and are generally harvested before they reach 80 years old.

Alternative A would have no negative cumulative effects.

Effects of Alternatives B, C, D, E, F, and G (Preferred Alternative) on Bald Eagle

Salvage

Direct and Indirect Effects

Under all action alternatives (B-G), no known bald eagle nesting or roosting habitat would be removed. Roadside hazard salvage and salvage of dead trees may remove some trees which could be used by eagles to perch. There are no known roost or nest trees in the watershed. All proposed projects would be "No Effect" on bald eagles.

Impacts from salvage would be negligible under all action alternatives.

Restoration

Direct and Indirect Effects

Approximately 50 acres would be thinned to produce trees suitable to support a bald eagle nest. This would provide no direct effect in the short-term. In the long-term (30-60+ years) trees in these areas would provide large open-grown conifers which would improve potential nesting habitat.

Thinning to improve eagle nest habitat would not occur under Alternative F.

Oak woodlands and meadow restoration would improve foraging opportunities (for rabbits, small rodents, etc.) in the meadows.

Restoration projects to thin and improve the development of large trees, including pines, would accelerate the development of late-successional and old-growth stands. Eagles would use these stands for roosting and nesting if the stands were in a suitable location, such as near an open meadow or overlooking Elk Creek.

None of the other proposed restoration projects would have an effect on eagle habitat.

Cumulative Effects

Proposed actions in timber sales on BLM and USFS lands within the adjacent 5th field watersheds would not affect the ability of eagles to migrate between 5th field watersheds.

Increasing the areas with suitable nest trees on the ridge between the Elk Creek and Lost Creek watersheds would provide a beneficial effect. Eagles remain a USFWS Threatened species. Providing future nest habitat would benefit the reproductive success of eagles and could contribute to future delisting efforts.

Industrial forest land does not contribute to the late-successional forest in the watershed. The stands are managed for maximum timber production and are generally harvested before they reach 80 years old.

Land Birds (Neotropical Migrants and year-round residents)

USFWS released a list of Birds of Conservation Concern in February 2002. This list included six species known to be present in the BLM Medford District: peregrine falcon, flammulated owl, rufous hummingbird, Lewis's woodpecker, white-headed woodpecker, and olive-sided flycatcher.

Peregrine falcons would be protected with a ½-mile buffer and/or a seasonal restriction, and would not be impacted by any proposed action. Surveys of suitable cliffs inside the fire boundary in the summer of 2003 were negative.

See Section 3.12.3.2 for discussions on flammulated owls and other cavity and down wood dependent species.

Restoration

Direct and Indirect Effects

No proposed restoration projects would alter green canopy density. This would have negligible effect to local birds on the USFWS list.

Cumulative Effects

There is no anticipated change in management on BLM and USFS lands in the Elk Creek Watershed. Birds are highly mobile and would be able to disperse across the 5th field watershed and into adjacent watersheds.

Private lands provide habitat for a wide variety of early and mid-seral dependent birds. Pre-commercial thinning and regeneration harvest on private lands within this watershed and adjacent watersheds would encourage the growth of forbs and shrubs. This benefits birds that use early seral deciduous vegetation and nectar producing plants, such as hummingbirds and orange crowned warblers.

Effects of Alternative B on Land Birds

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur. Effects would be the same as Alternative A.

Restoration

Direct and Indirect Effects

Any change in vegetation would benefit some bird species at the expense of others. Density management would reduce habitat for birds that use mid-seral forest, deciduous sub-canopy, and understory trees. At the same time, there would be a corresponding increase in habitat for early seral forest users.

Thinning is proposed on 1,375 acres of 10-30 year old stands with greater than 40 percent canopy closure. Forbs and deciduous shrubs remaining after thinning would provide habitat for rufous hummingbirds.

In 60-80+ years, these stands would provide habitat for birds that use the mature forest and multilayered forest, such as brown creeper, pileated woodpecker, and pacific-slope flycatchers. Other birds use forest edges. Olive-sided flycatchers, for example, will perch on trees at the edges of stands and fly out to capture insects in the openings.

FMZs would reduce the mid-story and understory canopy in 1,300 acres. This would benefit the species which forage in the open areas beneath the canopy, such as Hammond's flycatchers.

FMZ treatments would remove some habitat for Wilson's warbler and orange-crowned warblers, species associated with deciduous shrubs and trees in early-successional habitat.

Where there is a well-developed deciduous shrub layer, other parts of the watershed would provide habitat. As they recover from the fire, deciduous shrubs would be present in the high burn severity stands Habitat features for Wilson's warblers and orange-crowned warblers would be present in these stands.

Cumulative Effects

Snags on BLM-administered lands would remain at current levels, unless they were identified as hazard trees along roads.

Timber sales and restoration projects planned in adjacent watersheds would change some of the habitat used by various birds, but improve habitat for others. Thinning would remove brush and vegetation in the understory, improving foraging for flycatchers, but reducing suitability for winter wrens. Connectivity and dispersal between watersheds would still be viable.

Burned trees on industrial forest lands have been salvaged. This removed habitat for primary cavity excavators and provided habitat for early seral birds as they recover from the fire.

Industrial forest lands would provide an average of two snags per acre. There would be a reduction of future habitat for snag-dependent species on those lands. However, more snags are present in the entire watershed after the fire than pre-fire, providing an overall benefit to the species that use dead trees.

Stumps and cull decks on industrial forest lands would provide foraging and nesting sites for some species of birds. White-headed woodpeckers will sometimes use stumps for nesting.

Throughout Elk Creek Watershed, habitat for species that use deciduous shrubs and trees in early-successional habitat would increase in the next 5-10 years as the forest vegetation returns in the areas with high and moderate burn severity.

This would remain the same for all alternatives.

Effects of Alternative C and D on Land Birds

Salvage

Direct and Indirect Effects

Salvage is proposed on 247 acres in Alternative C and 820 acres under Alternative D. Roadside salvage would occur on 1,078 acres for Alternative C and 1,064 acres under Alternative D.

Salvage would only occur in areas with high and moderate burn severity greater than ten acres and less than 40 percent canopy closure.

Salvage would be limited to a maximum of 20 percent in areas where snag densities exceed the typical snag density by more than 20 percent in Alternative C. Alternative D would leave 8-17 snags per acre plus additional snags to meet down wood cover. There would be little difference in the impacts due to the numbers of snags left.

Although the scale is different, species of birds that use large snags for foraging, such as woodpeckers, or hunting perches, such as olive-sided flycatcher, would benefit from large numbers of snags left near and inside green stands.

The impact to USFWS Birds of Conservation Concern 2002 would be negligible.

Restoration

Direct and Indirect Effects

The effects of Alternatives C and D would be similar to Alternative B. The scale is different, but the effects would be the same. Birds that use pines, such as flammulated owl, white-headed woodpecker, and Lewis's woodpecker, would benefit from pine restoration.

Any change in vegetation benefits some bird species at the expense of others. Density management would reduce habitat for birds using the dense understory of mid-seral forest and increase habitat for early seral forest, stand initiation users.

Thinning would occur in 10-30 year old stands as well as older stands (30-80 years). Thinning, by creating a more open, multilayered forest, would improve habitat for birds that use mature forests, such as brown creeper, pileated woodpecker, and pacific-slope flycatchers.

FMZs would reduce the mid-story and understory canopy in 1,300 acres. This would benefit the species, such as flycatchers, that forage in the open areas beneath the canopy.

Cumulative Effects

Snags would be left in patches and would be well distributed across the watershed. The impact to birds which use secondary cavities, such as Lewis's woodpeckers and bluebirds, would be low because the amount of area left unsalvaged is small.

The proposed action would not reduce the viability of any species on the Birds of Conservation Concern 2002 list in the BLM Medford District.

Restoration projects would be designed to improve late-successional habitat trajectories. Thinning, including FMZs, would favor growth of flowering plants beneath the canopy and would benefit the nectar producing flowers used by hummingbirds.

Effects of Alternative E on Land Birds

Salvage

Direct and Indirect Effects

Under Alternative E, area salvage would occur on 3,269 acres. Roadside salvage would occur on 536 acres.

Within the high burn severity stands, there would be little recruitment of large snags in the next 80-100 years, until the stands recover.

Snag patches within green stands provide valuable habitat for several species of woodpeckers and cavity dependent species.

Restoration

Direct and Indirect Effects

Effects from restoration projects proposed under Alternative E would be the same as Alternative B.

Cumulative Effects

There would be a reduction of snag and cavity habitat in the high to moderate burn severity areas as well as those areas within the green stands with light underburn. Because the highest number of snags and the snags within the green stands would be removed, the impact would be higher than the other alternatives.

Habitat is still available within the watershed for the species of concern. The actions proposed under Alternative E would not decrease the ability of the species to nest in the watershed. Species would be able to migrate to adjacent watersheds and the viability of the species would not be reduced.

Effects of Alternative F on Land Birds

Salvage

Direct and Indirect Effects

Under Alternative F, no salvage would occur outside the green stands in the high and moderate burn severity areas. This would leave large areas adjacent to green stands to provide habitat for birds such as olive-sided flycatcher which often forage at the edge of green stands by perching on snags and large trees and flying out to capture flying insects.

Within the green stands, only 2- to 10-acre patches between would be salvaged. A minimum of two acres in each green pocket would be left intact. Effects within the green stands where salvage occurred would be the same as Alternative E.

Restoration

Direct and Indirect Effects

Thinning would not occur in the young stands to promote the development of late-successional habitat. There would be no change in trajectory of these stands, and no new growth of forbs and shrubs would occur after thinning opens the canopy.

Oak woodlands and meadows would be burned and thinned, opening the understory and increasing growth of forbs in the grasslands. This benefits species dependent on nectar and berries.

FMZs would be established on 1,300 acres. Species such as Wilson's warbler and orange-crowned warbler are associated with deciduous shrubs. There would be some reduction of habitat for these species in the FMZs. However, the deciduous shrub and early-successional habitat would be abundant in the watershed in high to moderate burn severity areas as the vegetation recovers. Deciduous shrub and small tree habitat would be abundant for the next 20-30 years in the watershed.

Cumulative Effects

There would be a reduction in snag and cavity habitat within the green stands.

Connectivity between the 5th field watersheds would remain for other land birds. There would be an increase in the open understory on the ridges where the FMZs are placed. This would improve habitat on the ridges for birds, such as flycatchers which use the open areas under the canopy to forage. Nectar producing forbs would increase in an open understory, benefiting hummingbirds.

Species using the deciduous understory and shrubs would not be affected by the proposed actions in this or adjacent watersheds. Deciduous shrubs are abundant throughout the area.

Effects of Alternative G (Preferred Alternative) on Land Birds

Salvage

Direct and Indirect Effects

Under Alternative G, salvage would occur on 679 acres in the high and moderate burn severity stands where snag patches are greater than 10 acres with less than 40 percent canopy. Intensive roadside hazard would remove trees on approximately 70 acres. The remaining roadside salvage would remove scattered hazard trees, leaving the majority of the snags on-site. Stands with low to very low burn intensity would also not be salvage logged under this proposal.

Within the high to moderate burn severity stands that would be salvaged, there would be little recruitment of large snags in the next 80-100 years until the green trees grow to a size to begin providing large snags. Eight to twelve snags per acre would be left to meet snags and CWD requirements. There would be some reduction in habitat for birds that use large snags for foraging, such as woodpeckers. However, due to the high numbers of snags left on the landscape, impacts to other birds on the Birds of Conservation Concern list would be negligible. Snags would remain in low to very low burn stands, as well as high intensity stands with greater than 40 percent canopy. Birds such as pileated woodpeckers that are strong excavators create cavities in sound wood in both snags and live trees. Eighty-seven percent of the dead trees would remain (see Table 2-2).

All large snags within the green stands with greater than 40 percent canopy or less than 10 acres would remain to provide habitat for species that are primary excavators. Fire-killed trees can be case hardened, and may not provide good conditions for excavators for several years until decay begins to soften the wood. Snags present prior to the fire would not be salvaged and would remain to provide nesting habitat for land birds that use cavities and crevices for nesting. Canopy closure would also remain in green stands. Approximately 22 fire-created snags per acre would remain within the salvaged areas.

Birds that use secondary cavities and crevices, such as western bluebirds, Lewis' woodpecker, chickadees, nuthatches, etc., would have snags available to of them in increasing numbers over the next decade. Most of these birds use holes created by primary excavators, dig their nests in wood softened by decay, or nest under loose bark or holes created by broken limbs.

Olive-sided flycatchers were detected during bird surveys. They typically sit on tall trees at the edges of openings and fly out to capture insects. Snags left in patches and within the areas not salvaged would provide suitable perch trees for olive-sided flycatchers. Forty-seven percent of the stand-replacement acres would not be salvaged. This added to the green stands not salvaged would provide habitat for the flycatchers, and the proposed salvage would not lead to the need to list them as Threatened or Endangered.

Deciduous forbs and flowering shrubs would benefit from the fire, creating more habitat for rufous hummingbirds. Salvage would open some areas to sunlight by removing some shade, promoting growth of flowering forbs and shrubs for several years before the forest canopy becomes closed, shading out these plants.

Scientific research would be proposed under Alternative G in stands with high and moderate burn severity.

All research plots, except the control, would remove foraging habitat for birds which use dead wood. Snags would be available for foraging olive-sided flycatchers, although in reduced numbers in the stands with six trees per acre. Other treatments would have adequate snags available for the flycatchers.

The scope of the research sites is small and scattered around the landscape. Impact to birds is expected to be low. Deciduous shrub habitat, forbs, and grasses would not be reduced by the action.

Proposed research would determine the effect of salvage logging on birds. Results would be used in future determinations for the amount of snags necessary to meet the needs of land birds in the Western Cascade Province of southwestern Oregon.

Restoration

Direct and Indirect Effects

Under Alternative G, effects from restoration projects would be the same as Alternative C.

Cumulative Effects

Cumulative effects under Alternative G would be the same as Alternative C.

Big Game

Unless otherwise noted, big game considered in this section are deer and elk.

Effects of Alternative A (No Action) on Big Game

Salvage

Direct and Indirect Effects

Under Alternative A, no salvage would occur. There would be no change in big game habitat

Restoration

Direct and Indirect Effects

Proposed restoration projects under Alternative A would cause no change in big game habitat.

Cumulative Effects

Road density would continue at current levels. Roads currently open would remain open. This leads to continued opportunities for poaching and harassment of big game. Hunting pressure is usually high after a fire, as the new forage attracts deer and elk and hiding cover is reduced.

Private timber companies are currently placing gates on roads they control across private lands. This is being completed to protect private land investment, prevent wood theft, reduce erosion, and protect public safety. Public lands are present behind many of the gates, but there is no legal public access on the roads.

Industrial forest lands are managed for maximum timber production and are generally harvested before they reach 80 years. These lands usually remain in early to mid-seral condition. Shrubs and forbs growing after a timber harvest provide good forage for big game. This generally remains for 10-15 years, until the stands become dense and canopy begins to crowd out the understory shrubs deer and elk use for forage.

Federal lands in the watershed are being managed for late-successional habitat. Forage for deer and elk would decline on Federal lands in the LSR as habitat changes from early and mid-seral to late-successional habitat.

This would be the same for all alternatives.

Effects of Alternative B on Big Game

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur. Effects would be the same as Alternative A.

Restoration

Direct and Indirect Effects

Thinning on 1,375 acres would have a short-term increase in shrubs and forbs after the action (1 to 15 years). Forage would decline as the canopy reestablishes. Thinning would enhance habitat for bear which forage on berries, grasses, and other vegetation produced in the open burned areas.

Road restoration projects would have an impact on big game species. Road reconstruction would improve all-weather access. Vehicles could be driven on these roads during the winter months, increasing disturbance to big game. This effect would be the same in all alternatives.

Decommissioning (35 miles) and temporary closure (21 miles) of system roads would reduce areas where poaching and harassment of big game could occur. This would improve security for big game in the watershed, and offset the effects of road improvements.

Restoration of meadows and oak woodlands would improve forage in those habitats. Prescribed fire to reduce fuels in the understory would create better forage, as the old, less palatable brush is burned and re-growth begins.

Cumulative Effects

Under current NFP guidelines, there would be no planned green timber harvest on Federal lands over 80 years old in the watershed. This would reduce the amount of young, palatable forbs and shrubs that grow in the openings.

There would be a decrease the total amount of forage available for deer and elk on BLM-administered land in the watershed in the long term (30+ years). Hiding, fawning, or calving habitat would improve as the forest grows into late-successional forest. Private lands and future fuels management projects would provide forage for big game.

Effects of Alternatives C and D on Big Game

Salvage

Direct and Indirect Effects

Under Alternatives C and D, there would be some disturbance due to human presence during the time of the salvage operations. Removal of dead trees would not impact big game habitat.

Restoration

Direct and Indirect Effects

Under Alternative E, 35 miles of roads would be decommissioned, and 21 miles closed with a gate or barricade. This would reduce the disturbance to big game from people driving on the roads and decrease poaching opportunities.

Restoration would occur on 1,544 acres of oak woodlands. Effects would be the same as Alternative B, but more acres would be treated.

Cumulative Effects

Cumulative effects under Alternatives C and D would be the same as Alternative B.

Effects of Alternative E on Big Game

Salvage

Direct and Indirect Effects

Under Alternative E, there would be some disturbance due to human presence during the time of the salvage operations. Salvage operations near green stands could disturb big game and cause them to move out of the area. Removal of dead trees would not impact big game habitat.

Restoration

Direct and Indirect Effects

Approximately 114 miles of road would be closed to vehicle traffic from mid-October through April 30. This would reduce the amount of poaching and road hunting and limit access to foot traffic in many areas of the watershed during the late fall and winter months. Deer and elk security in the winter range areas would be improved and disturbance would be reduced.

Full or partial decommissioning would occur on 43 miles of road and 21 miles would be closed with a gate or barricade.

The effects of restoration proposed under Alternative E would be the same as Alternative B.

Cumulative Effects

Alternative E would have the highest benefit to wintering big game in the watershed. A seasonal road closure would close approximately 114 miles of road to motorized vehicles from mid-October to April 30.

Security for wintering big game would improve. Deer and elk would be protected from harassment, poaching, and other disturbances during the late fall and winter months when they are on the wintering grounds.

Restoration projects improving meadows and rejuvenating undergrowth would improve forage within the watershed. Alternative E would lead to an increase the survival of deer and elk and improve population numbers in southern Oregon

Effects of Alternative F on Big Game

Salvage

Direct and Indirect Effects

Under Alternative F, salvage would occur in 3- to 10-acre pockets of dead trees located within green stands. The green stands provide hiding, resting, birthing areas for big game. Operations within those stands could disturb big game and cause them to move out of the area.

Restoration

Direct and Indirect Effects

The effects from proposed restoration projects under Alternative F would be the same as Alternative B.

Cumulative Effects

Cumulative effects under Alternative F would be the same as Alternative B.

Effects of Alternative G (Preferred Alternative) on Big Game

Salvage

Direct and Indirect Effects

Under Alternative G, the effects from proposed salvage would be the same as Alternative E.

Restoration

Direct and Indirect Effects

The effects from proposed restoration projects under Alternative G would be the same as Alternative C and D except for the following.

Approximately 114 miles of road would be closed to vehicle traffic from mid-October through April 30. This would reduce the amount of poaching and road hunting and limit access to foot traffic in many areas of the watershed during the late fall and winter months. Deer and elk security in the winter range areas would be improved and disturbance would be reduced.

Cumulative Effects

Cumulative effects under Alternative G would be the same as Alternative E.

3.13 Grazing

Grazing refers to the grazing of domestic cattle on public lands.

Livestock use is permitted on Federal Lands through several authorities:

- Taylor Grazing Act of 1934, as amended;
- Federal Land Policy and Management Act of 1976, as amended by the Public Rangelands Improvement Act of 1978;
- Public Rangelands Improvement Act of 1978; and
- Public land orders, executive orders, and agreements authorize the Secretary to administer livestock grazing on specified lands under the Taylor Grazing Act or other authority as specified.

3.13.1 Methodology

Objectives of the range management program are to manage range vegetation to protect basic soil and water resources, provide for ecological diversity, improve or maintain environmental quality, and meet public needs for interrelated resource uses; to integrate management of range vegetation with other resource programs to meet multiple-use objectives; to provide for livestock forage, wildlife food and habitat, outdoor recreation, and other resources dependent on range vegetation; and to provide opportunities for economic diversity and promote stability for communities depending on range resources for their livelihood. There is very little "rangeland" in the vicinity of the fire. Most of the grazing is opportunistic, occurring in openings created by timber harvest activities or along roadsides. Grazing intensity and use patterns change as vegetation changes following stand-opening events, such as timber harvest or fire.

Monitoring is completed annually in several programs in the Medford District to determine whether or not objectives are being met. Fisheries and riparian biologists monitor stream conditions and streamside vegetation, and range specialists monitor trend study plots in the uplands to determine rangeland conditions. There are, however, no trend study plots established within the fire perimeter since most of the area is used for conifer production.

In allotments containing large, private ownerships (i.e., Boise Corporation), grazing is jointly and cooperatively administered.

3.13.2 Affected Environment

Five allotments, or portions of allotments, lie within the Elk Creek Watershed (see Table 3.13-1). Prior to the fire, forage conditions in the allotments were adequate to sustain all authorized livestock, while ensuring wildlife forage and habitat conditions were being met, as well as protecting soil conditions and water quality.

Table 3.13-1. Watershed Locations of Allotments (acres)

Watershed	Allotment Name				
	Flat Creek	Lost Creek	Clear Creek	Sugarloaf	Trail Creek
Elk Creek	25,809	12,682	2,518	607	-
Umpqua	34	-	-		
Trail Creek	1	-	1,325	959	4,616
Upper Rogue	-	75		-	-
Shady Cove	-	1,320		-	-
Lost Creek	-	12,682			

A portion of US Army Corps of Engineers (USACE) land, situated between the Flat Creek and Lost Creek allotments, was originally intended to be inundated following construction of Elk Creek Dam. This land, although unfenced, is not included in either allotment. A Memorandum of Understanding (MOU) between BLM and USACE allows limited use by livestock from the two adjacent allotments. Since mid-1990, that limited use was designed to reduce levels of yellow starthistle in preparation for the competitive seeding that took place in the fall of 2002, immediately following the Timbered Rock Fire. The contract for this seeding was awarded just prior to the fire, and work commenced just after control of the fire was attained.

3.13.2.1 Trail Creek Allotment

The Trail Creek Allotment lies west of the West Branch Elk Creek Road, and was untouched by the fire. Grazing was cancelled in this allotment in 1999.

3.13.2.2 Clear Creek Allotment

The Clear Creek Allotment lies west of the West Branch Elk Creek Road, and was not affected by the fire. The livestock operator grazes eight head of cattle from May 15 through October 31. If soils are not dry enough to withstand livestock use, grazing is deferred until soils dry.

3.13.2.3 Sugarloaf Allotment

The Sugarloaf Allotment lies west of the West Branch Elk Creek Road, and was not affected by the fire. The livestock operator grazes six head of cattle from April 15 through June

30. If soils are not dry enough to withstand livestock use, grazing is deferred until soils dry.

3.13.2.4 Flat Creek Allotment

Pre-fire

A single livestock operator uses this allotment. During a normal grazing year, 124 cattle are turned out on or around April 1. If soil conditions are too wet due to recent rains, turnout is deferred until soil conditions can withstand cattle use. On June 16, one-half of the cattle are moved north to a US Forest Service allotment. The remaining 62 cattle continue to graze until October 15 (see Table 3.12-2).

Table 3.13-2. Flat Creek Allotment

Grazing Dates	Head of Cattle		Animal Unit Month (AUM) by Land Jurisdiction	
	BLM	Boise	BLM	Boise
April 1 to June 15	72	52	180	148
June16 to October18	36	26	130	107
NOTE: An AUM is the amount of forage required to sustain one cow, or a cow and her calf, for one month				

Post-fire

Available livestock forage in this allotment was eliminated by the Timbered Rock Fire. As a result, livestock grazing has been deferred for a period of two years beginning 2003. This decision was reached in coordination with Boise Corporation, who authorizes grazing on their lands within the allotment. Authorization for this decision lies in the Code of Federal Regulations 43 CFR§4110.3-2(a), which states:

"Permitted use may be suspended in whole or in part on a temporary basis due to drought, fire, or other natural causes, or to facilitate installation, maintenance, or modification of range improvements."

Allowing two years rest from grazing would:

- Allow grasses and forbs to reestablish root systems impacted by the fire.
- Reduce the potential for soil disturbance by livestock grazing on steep slopes.
- Protect USACE lands recently seeded to reduce Yellow starthistle.
- Allow riparian areas to recover.
- Reduce damage to tree seedlings planted in fire rehabilitation efforts.
- Allow shrubs to resprout and reestablish.

Prior to the 2005 grazing season, an evaluation by the BLM and Boise Corporation will be conducted to determine whether livestock would be allowed to graze within the Flat Creek Allotment. Evaluation criteria may include, but not be limited to, soil stability, forage availability, condition of recovery efforts, water quality and quantity, and tree plantation success.

3.13.2.5 Lost Creek Allotment

Pre-fire

Three livestock operators use this allotment. Each operator uses a separate, unfenced region of the allotment. A portion of the use is authorized by Boise Corporation under a separate lease agreement (see Table 3.13-3).

Table 3.13-3. Authorized Livestock Use in Lost Creek Allotment

Allotment Area	Head of Cattle	Grazing Dates	AUMs	Land Jurisdiction
Northern portion	7	April 1-Oct. 15	46	BLM
	25	April 1-Oct. 15	163	Boise
Middle portion	20	April 1-July 15	70	BLM
	26	April 1-July 15	91	Superior
	10	April 1-Oct. 1	70	BLM
	55	April 1-Oct. 31	387	Boise
Southern portion	37	April 16-Sept. 30	204	BLM
	19	April 16-Sept. 30	105	Boise

Post-fire

A relatively small portion (861 acres or 2 percent) of the Lost Creek Allotment was affected by the Timbered Rock Fire (see Table 3.13-4). Of that, 413 acres were at moderate or high burn severity. Livestock will continue to be authorized in the Lost Creek Allotment and will use the allotment in 2003.

The rationale for use of the allotment is:

- The amount of acreage burned in this allotment was minimal (2 percent).
- The type of vegetation consumed was brush and trees, not grass.
- The burned portion is on steeper slopes that livestock cannot easily access.
- Adequate forage to sustain permitted livestock exists elsewhere within the allotment.

Table 3.13-4. Grazing Allotments Acres Burned within the Elk Creek Watershed

Name	Acres	Acres Burned	Percentage Burned
Flat Creek	25,844	21,506	80
Lost Creek	34,932	861	2
Clear Creek	3,843	0	0
Sugarloaf	1,566	0	0

Livestock operators would be required to keep cattle east of the burned area and away from Elk Creek. When and if livestock are observed or documented crossing Elk Creek and accessing the grass seeding on the west side of Elk Creek, the livestock operators will be notified and requested to remove their livestock. This decision was made by the Army Corps of Engineers.

Due to the likelihood of cattle crossing Elk Creek from the Lost Creek Allotment by late June, the grazing season in this allotment will be shortened in 2003 and possibly 2004. With the grazing season shortened by half, the Lost Creek Allotment should be able to sustain a larger number of livestock, and still not exceed its authorized AUMs.

3.13.3 Environmental Consequences

3.13.3.1 Effects of Alternative A (No Action) on Grazing

The No Action alternative would result in more forage available for livestock following the two-year deferment. As grasses and forbs reestablish themselves, forage levels would increase. This condition would remain until trees out-shade grasses and forbs.

3.13.3.2 Effects of Alternatives B, C, D, E, F, and G (Preferred Alternative) on Grazing

Timber harvest or restoration activities after livestock have been allowed to reenter the fire area may impact the movement of livestock and alter the distribution and utilization patterns.

Forage levels available to livestock following the two-year deferment period would increase dramatically. Areas available for grazing would change from year-to-year, depending on restoration and/or harvest activities. When units or project areas are entered into, and trees and vegetation are removed, or cut and dropped, the residual openings would then fill in with grasses and forbs, providing forage for livestock. When emphasis shifts to other project sites, they too would subsequently fill in with grasses and forbs and receive more livestock use.

The amount of forage available for wildlife and livestock is expected to be several times more than was available prior to the fire. This increased forage availability would keep both livestock and wildlife well-dispersed throughout the allotments. Livestock and wildlife access riparian areas for water throughout the grazing season. As summer temperatures increase, it is expected livestock would spend more time in and around riparian areas in search of water and shade. This increased pressure on sensitive areas would be closely watched to ensure detrimental levels of use do not occur. If unacceptable levels of use are observed, livestock will be removed.

Although the effects of each alternative differ, they would all result in adequate forage so the resumption of livestock grazing would remain unchanged.

This constant shifting of livestock use would ensure that no single area receives more utilization or use than is healthy for the system.

3.14 Roads

3.14.1 Methodology

Two Watershed Analyses have been completed for the Elk Creek Watershed. The BLM and USFS completed one in 1996 and the other was completed by Boise Corporation in 1999. Both found road erosion to be the primary management-related activity that delivers sediment into the streams.

The Boise analysis cited several strategies that could be used to reduce this sediment input into streams:

- Place durable gravel on road surfaces of segments that drain into streams.
- Block or decommission unused road segments, remove culverts, and seed.
- Revegetate or armor with rock large, raveling cutslopes.
- Direct road drainage to the forest floor for filtering, rather than into streams.

The condition of roads within the watershed was inventoried the winter of 2002-2003. An interdisciplinary team of Butte Falls Resource Area specialists was assembled to determine the transportation management objectives (TMO) for the watershed. The team incorporated current information, LSR objectives, and the strategies listed above to create the TMOs. They evaluated future transportation needs in the watershed and made recommendations for treatments to the roads. These recommendations cover a range from

improving to fully decommissioning road segments. The list of TMO recommendations by road segment are in Appendix O. The TMO process only looked at road segments owned or controlled by the BLM, as identified in the BLM GIS database.

3.14.2 Affected Environment

3.14.2.1 Road Density

Pre-fire

In 1996, road densities for the entire Elk Creek Watershed averaged 5.5 miles per square mile and ranged from 2.7 to 7.3 miles per square mile. Current road density for the watershed is 4.7 miles per square mile. Road densities above 4 miles per square mile are considered moderate to high. High road densities, especially within riparian areas, relate to modifications to stream channel morphology, riparian vegetation, sedimentation, and surface erosion rates (USDA and USDI 1996, III-20). Generally, two types of road density are discussed: road density for all roads within the watershed and road density of BLM controlled roads within the watershed.

Numbers were derived from the BLM GIS database winter 2002-2003 (see Table 3.14-1).

Table 3.14-1. Inventory of Roads in Elk Creek Watershed

Miles of Road	629.2
Square Miles	136.3
Road Density (miles/square mile)	4.7
Road Density, BLM controlled	4.5
Miles of Road in Riparian Areas	243.5
Miles of Road within Riparian Areas of Fish-bearing Streams	84.7
Miles of Road within Riparian Areas of Non-Fish-bearing Streams	158.8

Post-fire

No new roads were built during fire suppression. Dozer lines constructed during the fire were rehabilitated in the fall of 2002. Some short spurs were built across public lands to access private industrial forest lands under reciprocal right-of-way agreements. At the time of this analysis, the total amount is less than five miles. These agreements were made with the companies because the checkerboard ownership pattern created access problems. The agreements assist both the agency and private companies in management of their lands. Due to these agreements, there are constraints on decommissioning and road closures. The BLM cannot reduce or restrict access to lands in these agreements without the consent of the other party.

3.14.2.2 Road Maintenance

Pre-fire

When the Elk Creek Watershed was designated an LSR, road maintenance in the watershed was reduced. Since the LSR designation, there have been no timber sales and the associated road maintenance performed for timber haul. Annual funding specifically for road maintenance has declined since the early 1980s. Many short spur roads are overgrown and, due to rock wear, some gravel-surfaced roads have degraded to a condition below design standards. Some culverts are rusted and need replaced. Almost all stream-crossing culverts were installed when the standard culvert sizing was to accommodate a 50-year storm event. Current standards require new culvert installations to accommodate a 100-year storm event. Many ditches and culvert catch basins are blocked by material eroded from cutbanks. Within the last 10-20 years, rock quarries have not been used or were used without planning for future quarry entries. Some quarries no longer have usable rock for roads or other construction purposes. Since the LSR was created pump chances have not been regularly maintained and many need to have the pools cleaned, access ramps repaired, and inlet/outlet culverts replaced.

Post-fire

During fire suppression efforts, some overgrown and closed roads were reopened. This made road surfaces previously protected by vegetation more vulnerable to erosion. Rehabilitation work after the fire included rocking road surfaces; blading roads; brushing roadsides; and cleaning ditches, culverts, and catch basins. In the process, some culverts were damaged and flow capacities were reduced. More roads were identified as needing maintenance work ranging from minor ditch/culvert cleaning to road resurfacing and replacement of culverts. Several pump chances were cleaned during or immediately after the fire suppression efforts. Not all the rehabilitation work was completed with long-term goals in mind and additional work is needed to bring the road segments up to the designed standard.

Private industrial timber companies harvested on their lands during the winter of 2002-2003 and some maintenance to the roads used for timber haul was completed.

3.14.3 Environmental Consequences

Definitions

- Fully Decommission: Cross drain culverts would be removed, stream-crossings would have the culverts removed and stream channels restored, and potentially unstable fills would be removed. The roadbed would be ripped, seeded, and mulched, and blocked with an earth and log barricade. The road would be removed from the BLM transportation database.
- Partially Decommission: Stream-crossings would have the culverts removed and stream channels restored. Potentially unstable fills would be removed. The roadbed would be left in an erosion-resistant condition using water bars to drain ditches in case cross-drain culverts plug. An earth and log barricade would be placed at the beginning of the road. The road would not be removed from the BLM transportation database and may be used again in future years.
- Temporary closures: Gates or guard rail barricades would be installed. These roads would be open for administrative use by the BLM or industrial timber companies but closed to the public.

3.14.3.1 Road Density

Cumulative Effects Common to all Alternatives

Private industrial forest land owners would build less than 5 miles of short spurs across BLM-administered lands under the reciprocal right-of-way agreements. The reduction in road density would allow funding to be focused on the most important roads.

Effects of Alternative A (No Action) on Road Density

Salvage

Direct and Indirect Effects

Under Alternative A, no salvage would occur.

Restoration

Direct and Indirect Effects

There would be no restoration work undertaken in this alternative.

Cumulative Effects

Cumulative effects under Alternative A would be the same as Cumulative Effects Common to all Alternatives.

Effects of Alternative B on Road Density

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur.

Restoration

Direct and Indirect Effects

Under Alternative B, 33 miles of road would be fully decommissioned and 3 miles would be partially decommissioned. This would reduce the miles of open and native surface roads, and roads with inadequate rock to armor the surface and protect the roadbed. The number of short dead-end spurs and roads within riparian areas would decrease. In riparian areas, 12.4 miles of road would be fully decommissioned and .9 miles would be partially decommissioned.

Cumulative Effects

Cumulative effects under Alternative B would be the same as Cumulative Effects Common to all Alternatives.

Effects of Alternative C on Road Density

Salvage

Direct and Indirect Effects

Under Alternative C, approximately .25 miles of temporary roads would be constructed. These roads would be built and removed within the same operating season. There would be no long-term effect on road densities.

Restoration

Direct and Indirect Effects

Effects would be the same as Alternative B.

Cumulative Effects

Cumulative effects under Alternative C would be the same as Cumulative Effects Common to all Alternatives.

Effects of Alternative D on Road Density

Salvage

Direct and Indirect Effects

Under Alternative D, approximately .6 miles of temporary roads would be constructed. These roads would be built and removed within the same operating season and there would be no effect on road densities.

Restoration

Direct and Indirect Effects

Effects would be the same as Alternative B.

Cumulative Effects

Cumulative effects under Alternative D would be the same as Cumulative Effects Common to all Alternatives.

Effects of Alternative E on Road Density

Salvage

Direct and Indirect Effects

Under Alternative E, approximately 1.5 miles of temporary roads would be constructed. These roads would be built and removed within the same operating season and there would be no effect on road densities.

Restoration

Direct and Indirect Effects

Under Alternative E, 38 miles of road would be fully decommissioned, 5 miles would be partially decommissioned and 114 miles would be seasonally closed. This would reduce the miles of open and native surface roads, and roads with inadequate rock to armor the surface and protect the roadbed. The number of short dead-end spurs and roads within riparian areas would decrease. In riparian areas, 13.3 miles of road would be fully decommissioned and 1.7 miles would be partially decommissioned.

Cumulative Effects

Cumulative effects under Alternative E would be the same as Cumulative Effects Common to all Alternatives.

Effects of Alternative F on Road Density

Salvage

Direct and Indirect Effects

Under Alternative F, salvage activities would not require construction of new or temporary roads.

Restoration

Direct and Indirect Effects

Under Alternative F, 15 miles of road would be fully decommissioned and 2 miles would be partially decommissioned. This would reduce the miles of open and native surface roads, and roads with inadequate rock to armor the surface and protect the roadbed. The number of short dead-end spurs and roads within riparian areas would decrease. In riparian areas, 5.4 miles of road would be fully decommissioned and .6 miles would be partially decommissioned.

Cumulative Effects

Cumulative effects under Alternative E would be the same as Cumulative Effects Common to all Alternatives.

Effects of Alternative G (Preferred Alternative) on Road Density

Salvage

Direct and Indirect Effects

Under Alternative G, approximately .9 miles of temporary roads would be constructed. These roads would be built and removed within the same operating season. There would be no effect on road densities.

Restoration

Direct and Indirect Effects

Under Alternative G, 33 miles of road would be fully decommissioned and 2 miles would be partially decommissioned. This would reduce the miles of open and native surface roads and roads with inadequate rock to armor the surface and protect the roadbed. The number of short dead-end spurs and roads within riparian areas would decrease. In riparian areas, 12.4 miles of road would be fully decommissioned and .9 miles would be partially decommissioned.

Cumulative Effects

Cumulative effects under Alternative G would be the same as Cumulative Effects Common to all Alternatives.

3.14.3.2 Road Maintenance

Definitions
- Road Renovation: Blade road surface, clean ditches and culvert catch basins, clean or replace culverts, add culverts or rock to armor outlets, clean or construct drain dips, and brush roadsides.
- Road Improvement: All the work described in road renovation plus adding rock to the road surface.

Cumulative Effects Common to all Alternatives

Private industrial forest land owners would do maintenance on roads used for hauling timber. There would be minor work by BLM maintenance crews on mainline roads. There may be some minor work related to roadside hazard tree removal and any damage it causes.

Effects of Alternative A (No Action) on Road Maintenance

Salvage

Direct and Indirect Effects

Under Alternative A, no salvage would occur.

Restoration

Direct and Indirect Effects

Under Alternative A, no restoration would occur. There

would be minor work by BLM maintenance crews on mainline roads. There may be some minor work related to roadside hazard tree removal and any damage it causes.

Cumulative Effects

Cumulative Effects under Alternative A would be the same as Cumulative Effects Common to all Alternatives.

Effects of Alternative B on Road Maintenance

Salvage

Direct and Indirect Effects

Under Alternative B, no salvage would occur.

Restoration

Direct and Indirect Effects

Restoration work identified under the Transportation Management Objectives (TMO) process would include 76 miles of renovation and 24 miles of improvement. Seven pump chances would be improved and five rock quarries would be rehabilitated.

Cumulative Effects

Cumulative Effects under Alternative B would be the same as Cumulative Effects Common to all Alternatives.

Effects of Alternative C on Road Maintenance

Salvage and Restoration

Direct and Indirect Effects

Under Alternative C, maintenance would include 76 miles of road renovation and 24 miles of road improvements. Seven pump chances would be improved and five rock quarries would be rehabilitated.

Cumulative Effects

Cumulative Effects under Alternative C would be the same as Cumulative Effects Common to all Alternatives.

Effects of Alternative D on Road Maintenance

Salvage and Restoration

Direct and Indirect Effects

Under Alternative D, maintenance would include 76 miles of road renovation and 24 miles of road improvements. Seven pump chances would be improved and five rock quarries would be rehabilitated.

Cumulative Effects

Cumulative Effects under Alternative D would be the same as Cumulative Effects Common to all Alternatives.

Effects of Alternative E on Road Maintenance

Salvage and Restoration

Direct and Indirect Effects

Under Alternative E, all maintenance work recommended in the TMO process would be completed. This includes 86.6 miles of road renovation and 28.8 miles of road improvements. Eight pump chances would be improved and five rock quarries would be rehabilitated.

Cumulative Effects

Cumulative Effects under Alternative E would be the same as Cumulative Effects Common to all Alternatives.

Effects of Alternative F on Road Maintenance

Salvage and Restoration

Direct and Indirect Effects

Under Alternative F, maintenance would include 44.5 miles of road renovation and 23.8 miles of road improvements. Eight pump chances would be improved and five rock quarries would be rehabilitated.

Cumulative Effects

Cumulative Effects under Alternative F would be the same as Cumulative Effects Common to all Alternatives.

Effects of Alternative G (Preferred Alternative) on Road Maintenance

Salvage and Restoration

Direct and Indirect Effects

Under Alternative G, maintenance would include 76 miles of road renovation and 24 miles of road improvements. Seven pump chances would be improved and five rock quarries would be rehabilitated.

Cumulative Effects

Cumulative Effects under Alternative A would be the same as Cumulative Effects Common to all Alternatives.

3.15 Cultural Resources

3.15.1 Methodology

The methodology used to survey for the presence of archaeological resources adheres to guidelines set forth in the archaeological survey and reporting standards cultural resource survey protocol outlined by the Oregon State Historic Preservation Office (SHPO). This protocol outlines survey procedures which consist of dividing the land into high, medium, and low probability strata. Probability strata refer to the relationship between physiographic land type probability versus finding or locating archaeological sites. A 100 percent sample survey is required on high probability land, a 20 percent sample survey on medium probability land, and a 5 percent sample survey on low probability land. SHPO guidelines for cultural resource surveys require a 20 percent sample survey of the entire project area.

Information concerning archaeological sites that could potentially occur both inside and outside the fire perimeter was collected from the following sources:

- 1973 Lost Creek Archaeology Report
- 1974 Elk Creek Archaeology Report
- *People and the River: A History of the Human Occupation of the Rogue River of Southwestern Oregon*
- *Prehistory and History of the Rogue River National Forest: A Cultural Resource Overview*.

These publications, along with General Land Office background surveys and 1913 Revestment surveys, were used to predict the possible occurrence of archaeological sites.

3.15.1.1 Assumptions

Compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966 will be conducted before any surface-disturbing activity occurs. Project design features will be developed for mitigation purposes to protect archaeological sites. Surveys will be conducted using Oregon SHPO standard protocol. If archaeological sites are discovered in the survey, they will be protected.

3.15.2 Affected Environment

A large portion of the archaeological record in the Elk Creek area was derived from archaeological surveys and testing that occurred in the 1960s and 1970s. In 1966, David Cole from the University of Oregon performed the first archaeological survey of this area and recorded four sites. These sites consisted of lithic scatters and hearth features combined with grinding tools. Additional fieldwork by Wilbur Davis of Oregon State University consisted of survey and testing in 1966, 1967, 1968, and 1972, and data recovery excavations in 1973. Three of the sites were found to have house pits. Radiocarbon dates with some cultural significance were found at three other sites and some components produced projectile points. The above mentioned excavations took place on USACE lands located in the Elk Creek Watershed adjacent to BLM-administered lands.

In the summer of 1973, test excavations on USACE lands in the proposed Elk Creek Lake project area began. These test excavations unearthed prehistoric artifacts that included projectile points and grinding tools. In addition, single task-specific camps, semi-permanent camps, and pithouses were found, all attesting to the occupation of this area dating from prehistoric times.

In 1979, Oregon State University resurveyed the entire proposed Elk Creek Lake project area located on USACE lands. They located and recorded 15 undiscovered sites containing housepits and lithic scatters containing obsidian.

In 1999, the BLM contracted for a cultural resource survey of 20 percent of the adjacent Trail Creek Watershed. This cultural resource survey recorded 3 new sites and 10 previously known sites. The prehistoric site types ranged from small lithic scatters to projectile point isolates. The historic site types ranged from wooden cabins to homesteading flats. In addition, some survey was completed in 1997 and again in 1999 in the area of Sugarpine Creek and Alco Rock. However, no new sites were located, probably due to the small sample acres. It was a project-oriented survey consisting of less than 40 acres.

Based on past cultural resource surveys in Morine Creek and the adjacent Trail Creek and Lost Creek watersheds, limited historic and prehistoric archaeological sites were discovered.

The range of prehistoric cultural resource site types discovered in the project area include: village sites, seasonal camps, task-specific camps, and lithic scatters containing obsidian. Historic site types previously discovered in the project area include: trails and wagon roads, homestead sites, cabins, and fire lookouts built. These archaeological sites are important because they reflect the archaeological record of this project area as well as representing an important time in prehistoric and historic settlement of the upper Rogue River area.

In 1968, 3 of the 21 prehistoric sites recorded in the Elk Creek survey were pithouses. Pithouses represent a unique site type because they are very limited in the archaeological record.

Historic trails are unique because they served as an important transportation system for passage over and across the Rogue-Umpqua Divide.

Fire lookouts have also been documented in the Elk Creek Watershed. These sites reflect the beginnings of early timber management activities.

In prehistoric times, several Native American groups inhabited the Elk Creek Watershed area as well as the Upper Rogue River area. Prehistoric inhabitants of this area included: Upland Takelma, Mollala, and the Cow Creek Band of the Umpqua. Modern descendants with ties to the area include the Confederated Tribes of Siletz, the Cow Creek Band of the Umpqua, and the Confederated Tribes of Grand Ronde. There are no known traditional cultural properties identified in the Elk Creek Watershed area.

No previously recorded archaeological sites were impacted as a result of the Timbered Rock Fire. However, it should be noted that new archaeological sites may be discovered in the course of survey scheduled to begin in the spring of 2003. As is often the case after a fire, increased ground visibility results in increased ground exposure. This makes it easier to discover artifacts and archaeological sites. Any newly discovered cultural sites would be preserved and protected.

Looting of archaeological sites continues to be a problem in this watershed. Increased ground visibility caused by the burning off of dense vegetation on the forest floor increases the risk of looting. The BLM will continue to monitor known sites in this area to protect sites. Law enforcement and signing will be used.

Cultural resource surveys were completed for proposed timber harvest units, fuels reduction projects, and thinning units in 2003. The surveys followed compliance procedures for cultural resource surveys set forth by Section 106 of the National Historic Preservation Act. Specific guidelines outlined by Oregon SHPO according to *Protocol for Managing Cultural Resources* were followed. No new sites were located, however, two historic isolates were located and recorded.

3.15.3 Environmental Consequences

Proposed management activities with the potential to effect cultural resources include: timber harvest; fuels treatments; road improvement, renovation, and decommissioning; and stream enhancement projects. Adverse effects to archaeological/historical sites are most easily mitigated through site avoidance. Site avoidance would be accomplished through the use of Project Design Features. Where avoidance is not possible, scientific study of the effected sites would mitigate anticipated damage. Scientific study would require further consultation with Native American groups and other interested parties, and would require consultation with the State Historic Preservation Office and the Advisory Council on Historic Preservation. Since scientific study usually involves excavation, it would also require further environmental review to assess the effects on other aspects of the environment. When there are conflicts between the need to mitigate damage to sites through excavation and the need to protect other values, adverse effects to sites could occur.

Cultural surveys for specific proposed restoration projects that require Section106 survey under the NHPA will be conducted on an as-needed basis. These include new and temporary road construction, helicopter landings, and fish habitat improvement projects.

If archaeological sites are discovered, they will be protected and preserved by the BLM under the following Federal laws:

- Federal Land Policy and Management Act of 1976
- National Historic Preservation Act of 1966
- Antiquities Act of 1906
- Archaeological Resources Protection Act of 1979
- Reservoir Salvage Act of 1960
- American Indian Religious Freedom Act of 1978
- National Environmental Policy Act of 1960
- American Indian Freedom Act of 1978
- Native American Graves Protection and Repatriation Act of 1990.

3.15.3.1 Effects of Alternative A (No Action) on Cultural Resources

Salvage

Under Alternative A, the current level of cultural resource site protection from potential disturbance caused by management activities would be maintained. No salvage would occur although hazard trees would be cut along roads. Any hazard tree removal would pose a slight risk to cultural resources.

Restoration

Alternative A contains no restoration activities so this alternative would pose the least short-term risk to damaging or destroying cultural resource sites. Long-term, the risks to archaeological sites would increase over time if fuel loads were not reduced. The fires in southern Oregon during the summer of 2002 were extensive and represent the potential for large fires of this nature in the future.

3.15.3.2 Effects of Alternative B on Cultural Resources

Salvage

Under Alternative B, the current level of cultural resource

site protection from potential disturbance caused by management activities would be maintained. No salvage would occur although hazard trees would be cut along roads. Any hazard tree removal would pose a slight risk to cultural resources.

Restoration

The possibility of looting and unauthorized relic collecting at archaeological sites would increase under Alternative B through increased access to and visibility of archaeological sites. Looting could impact not only the archaeological site itself, but could render the scientific data generally collected from these sites impossible to interpret. This could happen equally under each of the action alternatives.

Fuels reduction projects under Alternative B would impact archaeological sites directly and indirectly. Fuels projects have the direct potential to disturb the surface of the ground where sites are located. Management guidelines which protect archaeological sites in fuels areas would be followed. Fuels reduction projects would benefit cultural resources in the long-term by reducing fuel loads. The continued growth of vegetation and the associated fuels accumulation would have an indirect impact to archaeological sites. High fuel buildup could cause stand-replacing fires which could burn and destroy historical archaeological sites. Prescribed burn would be proposed in several restoration projects. The possibility of a burn to escape exists. If this were to happen, historic and prehistoric sites and artifacts could possibly be harmed or destroyed.

Road reconstruction, road decommissioning, and stream-crossing upgrades under Alternative B would have a moderate risk for impacts to archaeological sites. Ground-disturbing activities could damage or destroy archaeological sites or their context. Many times these types of projects take place in areas considered high probability for locating archaeological sites such as stream edges or terraces.

3.15.3.3 Effects of Alternatives C, D, E, F, and G (Preferred Alternative) on Cultural Resources

Salvage

Ground disturbance resulting from salvage activities would increase under Alternatives C, D, E, F, and G. Of these, Alternatives C, D, and E have a somewhat higher potential for archaeological site disturbance or destruction resulting from higher impact harvest techniques coupled with an increased amount of acres scheduled for harvest. Management recommendations for site protection using PDFs would be followed.

The possibility of looting and unauthorized relic collecting at archaeological sites would increase under Alternatives C, D, E, F, and G through increased access and visibility of archaeological sites. Looting could impact not only the archaeological site itself, but could render the scientific data generally collected from these sites impossible to interpret. This could happen equally under each of the action alternatives.

Restoration

Fuels reduction projects included under Alternatives C, D, E, F, and G could impact archaeological sites. Fuels projects would have a moderate impact on cultural resource sites because of potential disturbance to the surface of the ground where sites are located. Management guidelines which protect archaeological sites in fuels areas would be followed. Furthermore, the continued growth of vegetation and the associated fuels accumulation could cause stand-replacing fires which could burn and destroy historical archaeological sites. During restoration projects proposing prescribed burns, the possibility of a burn escaping exists. If this occurred, historic and prehistoric sites and artifacts would be harmed or destroyed.

Road reconstruction, road decommissioning, and stream-crossing upgrades proposed under Alternatives C, D, E, F, and G would have a moderate risk for impacts to archaeological sites. Impacts would be caused by ground-disturbing activity which can damage or destroy archaeological sites or their context. Many times these types of project take place in areas considered high probability for locating archaeological sites, such as stream edges or terraces.

Fish habitat improvement projects would present a moderate risk to archaeological sites. Impacts would result from ground disturbance by heavy equipment in areas such as stream banks and edges. Impacts would also result from ground disturbance by heavy equipment entering and exiting the proposed project area to install fish structures.

Pine restoration, riparian thinning, and reforestation projects pose negligible risks to cultural resource sites.

Table 3.15-1 summarizes the potential for adverse effects by taking into account the possibility for mitigation of effects through site avoidance.

3.15.3.4 Cumulative Effects on Cultural Resources

No known archaeological sites were destroyed or damaged during the Timbered Rock Fire. In the area surrounding the Timbered Rock Fire, no known archaeological sites were impacted by the fire or fire suppression activities. Immediately following the Timbered Rock Fire, the BLM conducted an inventory which included surrounding watersheds to determine if any archaeological sites were

Table 3.15-1. Potential for Adverse Effects to Cultural Resources

Proposed Project	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E	Alternative F	Alternative G
Salvage	L	L	M	M	M	L	L
FMZ construction	N	L	L	L	L	L	L
Line Building	N	M	M	M	M	L	M
Roads	N	L	M	M	M	M	M
Fish Habitat	N	L	M	M	M	L	M

L-Low M-Medium H-High N-No impact

impacted or destroyed. Due to the large-scale area burned, cultural resource sites previously unknown or discovered could have been impacted. A cultural resource survey is planned for summer 2003. This survey has the potential to discover new sites especially due to the increased ground visibility that occurs following a wildland fire.

A cultural resource survey was conducted in 1999 on approximately 3,400 acres in the adjacent watershed of Trail creek. In addition, a cultural resource survey in the adjacent watershed area of Flounce Rock is currently underway and is scheduled to be completed in summer of 2003.

Several previously recorded archaeological/historical sites exist on USACE lands in the Elk Creek Watershed. Many of these archaeological sites were recorded during the proposed Elk Creek Dam surveys between the years of 1973 and 1983. Completion of this project would cause the loss of those sites.

Under all alternatives, salvage logging on adjacent private timberlands would increase the potential for fires to spread into the planning area should logging slash not be properly treated. As a result, a wildland fire could burn or destroy cultural resource sites.

3.16 Public Safety

- The level of risk for injury or property damage is higher within the fire perimeter than in adjacent unburned areas.
- The highest probability of injury or property damage is assumed to be along road ways and in areas of more frequent human activity.
- Existing hazards are expected to diminish over time, but new ones would develop as dead trees decay and become more unstable.

3.16.1 Methodology

Safety is assessed as the level of risk and probability of occurrence for personal injury and/or property damage. This discussion focuses on roadside hazards as well as more general area-wide hazards across the Timbered Rock Fire area. Consideration for level of risk focuses on worker and recreational visitor safety.

Guidelines for addressing forest worker safety are provided by the Occupational Health and Safety Administration (OSHA) (OAR 437-006) and BLM policy (BLM Handbook 1998, 1112-2 *Safety and Health for Field Operations*). These guidelines require forest workers to eliminate and/or mitigate hazards in the work environment.

Guidelines regarding visitor safety are more ambiguous. Unlike forest workers, the level and timing of visitor use is random and not as easily controlled. As a result, specific hazards and level of risk for an individual visitor is varied and hard to define. Given the presence of hazards on public lands, allowing use by forest visitors is provided, in part, by the Oregon Recreational Use Statute (ORS Title 10, Chapter 105, subsection 105.682). Under this statute, *"an owner of land is not liable in contract or tort for any personal injury, death or property damage that arises out of use of the lands for recreational purposes, woodcutting or the harvest of special forest products…"*.

3.16.1.1 Assumptions

- Unstable objects are the primary safety hazard in the fire area.
- The highest probability of serious injury or property damage is from standing dead trees.
- Due to higher levels of human activity, roadways and areas of intensive project work are considered the highest probability areas for injury or property damage.
- The probability of a serious accident or injury is assumed to be low due to relatively low visitor use and safety compliances required by forest workers under OSHA and BLM policy.
- To comply with OSHA requirements, hazard trees would be felled as identified.

3.16.2 Affected Environment

Unstable objects are the primary safety hazards existing within the fire area. Unstable objects, such as trees, rocks, logs, loose soil, or other objects, have the potential for movement and can result in personal injury and/or property damage. The Timbered Rock Fire resulted in the creation of standing snags (hazard trees) and areas of exposed soils across the landscape. In roadways, stumps or roots in the road prism have burned, leaving holes and areas of instability.

Compared to lands outside the fire, the presence of unstable objects and driving hazards are at a higher level. This increases the risk for personal injury or property damage to workers and forest visitors. With consideration to the type of hazards (standing dead trees), the consequences of an accident are potentially extreme.

Although the level of risk has increased, the probability of personal injury or property damage is generally low or very low. Many areas within the fire area are steep and isolated, and experience infrequent human activity. In areas of more frequent human activity, the probability of injury or property damage is increased. The highest areas of human activity are along travel routes (roads) and areas of project work (timber harvest and restoration activity).

General forest visitor activity is assumed to be highest along roadways. There is, however, a lower level of area-wide use for hunting and other miscellaneous recreational activities (firewood cutting, mushroom picking, etc.).

3.16.2.1 Roadside Hazards

Approximately 212 miles of roadway exist within the Timbered Rock Fire perimeter. On industrial forest lands, hazard trees have, for the most part, been removed as a result of salvage activity. On BLM-administered lands, hazard trees and/or potential hazard trees remain.

Due to the fire consuming much of the ground cover, there has been an increased incidence of rocks, logs, and soil moving onto the roadways. The highest potential for this occurring is during storm periods and in areas with steep side slopes or cut banks.

Hazards have essentially been removed on primary roads and most secondary roads. Weather events (settling), on-going road maintenance, and salvage logging of private industrial forest lands have worked together to remove most of the roadside hazards. With time and natural revegetation of burned areas, soil and other hazards would stabilize and the probability of unstable objects existing along roadways would continue to decrease.

In unharvested areas, potential hazard trees would continue to exist as fire-killed trees decay and lose rooting strength. Literature review indicates stand break-up and tree fall accelerates approximately five years following a fire. In Eastern Washington, Douglas-fir was found to have greater than 25 percent stem breakage below the crown level after 5 years, with the tops of larger diameter stems breaking off after 8 to 10 years (USDA 2000, Section II).

3.16.2.2 Project Work Areas (Area Hazards)

The primary safety hazard within project work areas is the presence of snags. The potential of a snag being considered a hazard tree is dependent on the condition of the tree, its position relative to human activity, and weather conditions. A danger tree (hazard tree), as defined by Oregon OSHA (OAR 437-006-005), is "*A standing live or dead tree, including snags, with evidence of deterioration or physical damage to the root system, trunk or stem. When determining if a tree is dangerous, the degree and direction of lean is an important factor*." Recent dead, undamaged trees and trees leaning away from activity areas pose a minimal risk given calm winds. However, older dead trees, damaged trees, and windy conditions increase the probability of an incident occurring.

Hazards from unstable objects, such as rocks, logs, and loose soil (poor footing) are also present. The probability for these objects to move is dependent on the trigger mechanism. Given the time since the fire, heavy rains or human activity are the only likely sources which could cause an unstable object to move.

As with hazards along roadways, time and natural re-vegetation of the landscape is reducing the level of potential hazards throughout the fire area. Hazard trees would continue to exist, however, as currently "stable" fire-killed trees decay and lose their rooting or stem strength. The potential of hazard trees causing injury or damage would still be dependent on the presence of humans when a given tree falls.

3.16.3 Environmental Consequences

As mentioned in Sections 3.16.2.1 and 3.16.2.2, safety concerns from unstable objects would be reduced naturally over time. Revegetation, settling from storms, and ongoing maintenance activities would minimize the level of risk from rolling debris and loose soils. Snags and existing road damage remain as the primary safety factors to address with respect to proposed actions.

This discussion summarizes the effects of alternatives based on the level of risk and potential for occurrence of personal injury and/or property damage. The direct, indirect, and cumulative effects are limited to the fire area only. This is because the hazards being considered are space and time

specific to the Timbered Rock Fire and do not affect a change in conditions outside the fire perimeter.

OSHA requires mitigation of hazards for forest workers with specific guidance towards hazard trees and roads (OAR 436-006-0380 and 0095). As a result, all alternatives would provide for worker safety as an ongoing activity. The difference between alternatives in effects for forest workers would be the level of risk elimination versus risk mitigation.

Visitor use and potential exposure to hazards is harder to define. Effects for visitor use are best described as potential level of exposure to hazards assuming continual use.

The effects of each alternative on safety are also variable when considering roadside versus area-wide hazard level.

3.16.3.1 Road Hazards

On BLM-administered lands, roadside hazards would be reduced with removal of hazard trees, road renovation work, and road access management. The level of roadside hazards would be similar across all alternatives with the exception of Alternatives A and B.

Effects of Alternative A (No Action) on Road Hazards

Direct and Indirect Effects

Alternative A would have no planned hazard tree removal or additional road renovation work.

An estimated 20-30 miles of roadway would continue to have standing dead trees adjacent to them. To meet OSHA safety requirements, known hazard trees would be cut as workers use various road systems. Hazard trees would also be cut where there is a threat of property damage to adjacent landowners.

In time, as trees continue to decay and break up, many trees along primary roads would be cut to meet OSHA requirements. For forest workers, retaining dead trees adjacent to the roadway increases the potential a hazard tree could go unnoticed. Forest visitors would have access along roadways that may or may not have existing hazard trees removed.

Associated driving hazards, such as burned out holes, road failures, or soil movement, would exist on secondary roads. Hazards along main roads would be removed as a result of logging activity on private lands. The Timbered Rock ESRP (2002) would also treat approximately 15 miles of road on BLM-administered lands. This would mitigate driving hazards where this treatment occurs.

Effects of Alternative B on Road Hazards

Direct and Indirect Effects

The level and condition of hazard trees would be the same as described for Alternative A. Driving hazards, however, would be reduced for both forest workers and visitors as a result of increased road restoration. Approximately 100 miles in road work would occur which would stabilize road beds, improve drainage, and enhance overall driving conditions. Approximately 50 miles of secondary road would be closed, eliminating the need to maintain them for safe travel.

Effects of Alternatives C, D E, F, and G (Preferred Alternative) on Road Hazards

Direct and Indirect Effects

Alternatives C through G would have existing and potential hazard trees removed except in riparian areas. Within riparian areas, hazard trees would be cut as they decay and pose a risk. As a result, the potential of injury or property damage from standing dead trees would be eliminated along roadways (excluding roads within riparian zones). This would benefit both forest workers and visitors.

Associated driving hazards on primary and secondary roads would also be dramatically reduced. As described in Alternative B, similar amounts of roadwork are planned for each alternative. Harvest activities would provide for additional road clearing and maintenance. This would result in road conditions similar to roads in unburned forested areas.

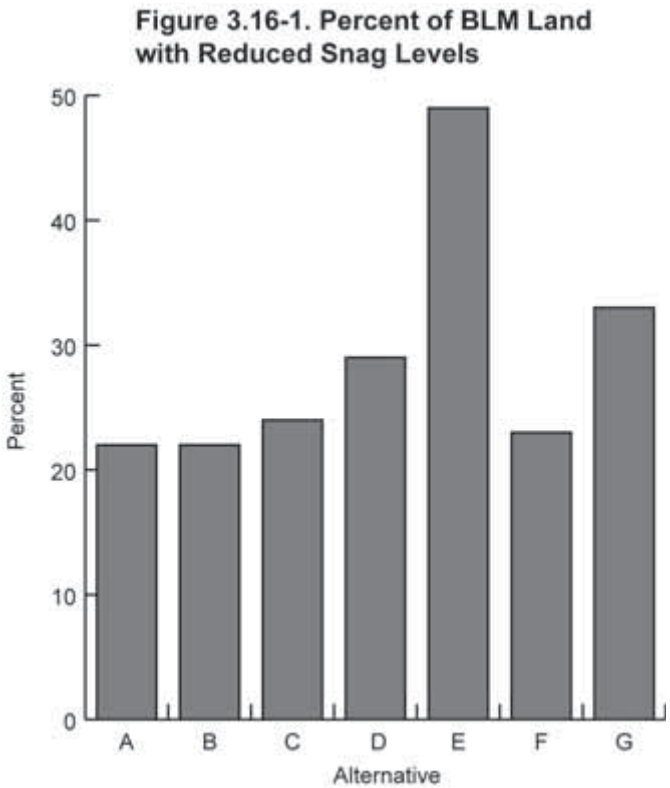
3.16.3.2 Area Hazards

Snag presence is the primary hazard which would be reduced on an area-wide basis. Figure 3.16-1 provides an estimate of the percent area which would have no snags or reduced snag levels on BLM-administered lands in the fire area. Figures include existing non-forest lands and plantations.

Effects of Alternatives A, B, C, D, F, and G (Preferred Alternative) on Area Hazards

Direct and Indirect Effects

Alternatives A, B, C, D, F, and G are similar in level of risk for both forest workers and forest visitors. There are some minor differences between alternatives with respect to level of harvest and restoration work. Where harvest does occur, all trees would be removed in the form of patch cuts. This follows recommendations in the LSRA of providing for worker safety in logging operations by removing all trees in an area of harvest. Alternative G, however, would have approximately 282 harvest acres in which 6 snags/acre would be reserved. Retaining snags in Alternative G would require careful consideration of which trees are stable enough for operations to occur safely.



Harvest activity in these alternatives would retain snags, in untreated areas, at relatively high levels across BLM-administered lands. Higher levels of harvest, such as in Alternative D or G, would reduce the area where snags are present. Higher levels of restoration in Alternatives C, D, or G, however, would increase the level of worker activity in areas with hazard trees present.

Forest workers would be required to cut known hazard trees or avoid activity in the area of risk. Restoration work, such as tree planting, would occur soon after the fire. As a result, there would be less potential for tree decay to be a contributing factor in the level of hazard trees present within work areas. Restoration work five years after the fire, however, would occur with the presence of advanced tree decay within work areas.

Forest visitor use, such as mushroom picking and hunting, would increase as a result of the fire. Visitors would be exposed to the same snag levels as forest workers. A key difference is that mitigation of hazards would not be provided for individual visitors. The ability to recognize potential hazards may be less than that of forest workers.

Effects of Alternatives E on Area Hazards

Direct and Indirect Effects

Alternative E would have a greater difference in hazard condition from Alternative A due to a higher level of harvest and restoration activity. Harvest would remove snags across the entire fire area and occur at a high enough level to effectively reduce the number of potential hazard trees present.

Due to higher levels of forest worker activity, there would be an inherently greater exposure to risks. These risks would primarily be associated with harvest activities. Snags would be retained in riparian areas and a range of 8 to 12 snags/acre would be evenly distributed in the uplands. Snags evenly distributed in harvest areas would be more problematic to operate around. Retaining snags would require careful consideration of which trees are stable enough to operate machinery around without placing workers at risk of injury.

Restoration work occurring in riparian areas would have the same risks as described for other alternatives. Risk exposure for restoration work in the uplands would be lower than in other alternatives. This is due to higher levels of harvest and retention of snags considered more stable.

Forest visitors would be exposed to a much lower snag level overall. As trees decay there would be appreciably fewer trees to be aware of and a reduced potential of damage or injury resulting from a falling snag.

Cumulative Effects

Regardless of which alternative is implemented, private land management activities would reduce hazard trees on private

Table 3.16-1. Roadside Treatments by Alternative

	Alternative						
	A	B	C	D	E	F	G
BLM-administered Land							
Miles of Road Improved	15	103	103	103	118	71	103
Miles of Road Closed	0	35	35	35	43	17	35
Roadside Hazard Trees	0*	0*	Removed	Removed	Removed	Removed	Removed
Privately-owned Land							
Miles of Road Improved**	Improved	Improved	Improved	Improved	Improved	Improved	Improved
Miles of Road Closed	99	99	99	99	99	99	99
Roadside Hazard Trees	Removed	Removed	Removed	Removed	Removed	Removed	Removed

* Hazard trees would be cut as needed for OSHA compliance
** Private land road improvement - For logging purposes. Includes multiple land ownerships.

lands and improve driving conditions along primary roads. An estimated 6,000 acres of salvage logging and related road work would occur on private industrial forest lands.

Several roads controlled by private industry have been blocked. These closures eliminated access to most lands from the Flat Creek drainage south to the edge of the fire along Elk Creek and West Branch Elk Creek roads. The level of access restriction on privately-controlled roads is unknown. Where access is restricted, however, the potential of road hazards affecting forest visitors on public and private lands would be reduced.

With consideration of activities on private lands and existing safety regulations, the level of risk due to existing hazards would be reduced to a condition where the likelihood of an accident or injury is relatively low across the fire area. On BLM-administered lands, levels of snag removal and road improvement are the factors which would contribute to reducing hazards in the fire perimeter. Tables 3.16-1 and 3.16-2 summarize the levels of hazard reduction by ownership for the fire area.

Due to activities on all land ownerships, the majority of roads would either be improved or have access restricted to forest visitors. Roadways which are improved for logging operations, however, would need additional maintenance once activities are complete. On private lands, the planned level of post logging maintenance is unknown. On BLM-administered lands, Alternative A would provide improvement from only those activities identified by the Timbered Rock ESRP.

On BLM-administered lands, level of risk would be reduced along roads for alternatives that would harvest roadside hazard trees. Higher levels of harvest would reduce area-wide snag levels, indicating a reduction in overall risk level. The benefit of snag reduction, however, is dependent on time and level of activity within the burn area.

All alternatives would retain snags across BLM-administered lands at varying levels. Limited use of areas with high snag levels would pose a similar level of risk as high use areas where snag levels are lower but still present. As a result, the benefits of snag reduction relates directly to the expected level of use. For forest visitors, use levels away from roads is unknown and cannot be measured. For forest workers, restoration activity would be higher in areas of high severity fire. As a result, level of snag reduction is only a general indicator of risk reduction. Adherence to existing safety policies described in Section 3.16.1 would be more critical in providing for worker safety regardless of snag reduction levels.

3.17 Economics

- On BLM lands, approximately 100 million board feet of merchantable fire-killed timber exists within the Timbered Rock Fire perimeter
- Nearly 1,700 acres of developing plantations were burned in the Timbered Rock Fire. An estimated $900,000 had been invested in these plantations.
- Under the Timbered Rock Fire Burned Area Emergency Stabilization and Rehabilitation Plan (ESRP), approximately $3.4 million dollars were requested for restoration and stabilization projects within the fire area.

3.17.1 Methodology

Economics focuses on the market benefits and costs as a result of proposed management alternatives.

Economic recovery consists of the volume and market value of fire-killed timber that would be harvested. Volume harvested is used as an indicator for resultant employment levels and potential employment income to the local economy. Timber values are revenue available to the Federal Treasury and potential dollar flow through the regional

Table 3.16-2. Summary of Area-Wide Snag Levels

	Alternative						
	A	B	C	D	E**	F	G**
Snag Reduction (acres)							
BLM-administered land*	0	0	247	820	3,269	213	961
Other Federal land***	0	0	0	0	0	0	0
Private land	6,000	6,000	6,000	6,000	6,000	6,000	6,000
BLM-administered land with reduced snags (12,000 acres)	22%	22%	24%	29%	49%	23%	30%
Fire area with reduced snags (21,000 acres)	66%	66%	67%	69%	78%	67%	70%

*Excludes roadside hazard tree removal.
**Alternatives E and G retain 6 to 12 snags/acre in harvest areas.
*** Level of treatment is currently unknown.

economy from the manufacture and sale of a product. Timber volumes are estimated from inventory data completed in the fall of 2002 and timber values are based on estimated sale receipts to the Treasury and the estimated value of processed timber.

The indicators used to measure effect on society are employment, employment income, and commodity output values.

Investments in restoration are costs incurred by the Federal Treasury to benefit the non-market values addressed by other resource sections in this chapter.

3.17.1.1 Assumptions

Economic recovery of fire-killed trees and investments into restoration are the two primary management activities that have a direct and quantifiable effect on the economy of southwest Oregon. Other resource sections of this chapter focus on the non-market values. Associated economic factors, such as miscellaneous forest products, would be implemented through the existing Northwest Forest Plan (USDA and USDI 1994b, C-16 to C-19) using the recommendations in the Late Successional Reserve Assessment (USDA and USDI 1998b, 185-187). Ongoing fire rehabilitation would be implemented through the existing Timbered Rock Fire ESRP (2002).

Employment and revenue figures provided in Section 3.17.3, assume set values. Variables, such as market shifts, wages, and level of activity, would increase or decrease the actual value of a given action.
There is a possibility that unforeseen factors, such as advanced wood decay or unmapped riparian areas, would reduce the level of timber harvest. Conversely, wood decay could be lower and more fire-killed trees could exist than estimated. As a result, harvest value and the level of activity could be lower or higher than described.

For analysis purposes, estimates of economic values are assumed to be static and intended to provide for a relative comparison of implementing various alternatives.

3.17.2 Affected Environment

Historical and current uses of the Elk Creek Watershed are documented in the Elk Creek Watershed Analysis (USDA and USDI 1996, II-57-65). Regional economics are also discussed in the Northwest Forest Plan (USDA and USDI 1994a, 3&4 261-319). These documents adequately describe the general pre-fire socioeconomic condition of the Elk Creek Watershed at the regional and local level.

One primary variation from the economic setting is that actual timber harvest, a primary driver of economic, community, and social effects, has lagged behind levels projected in the Northwest Forest Plan (USDA and USDI 2001b, 422). A recent report by economists from the State of Oregon, Oregon State University, and the Oregon Employment Department, indicates that the effects of reduced harvest has resulted in most displaced timber workers either earning lower wages or disappearing from covered employment roles in Oregon (Helvoigt 2003).

Using this broad-scale setting as background information, relevant issues to discuss are the pre- and post-fire conditions with respect to timber resources and restoration.

3.17.2.1 Volume and Value of Timber Resources

Pre-fire

On BLM-administered lands, an estimated 315 million board feet of merchantable timber exists within the Elk Creek Watershed. Since the approval of the Northwest Forest Plan in 1994, these lands were totally allocated to LSR which has no scheduled or “Probable Sale Quantity” expectations. Given this, commercial harvest of timber is not expected to contribute to the expected harvest levels identified by the Northwest Forest Plan. As a result, commercial harvest on Federal lands within the watershed has been essentially non-existent since 1994.

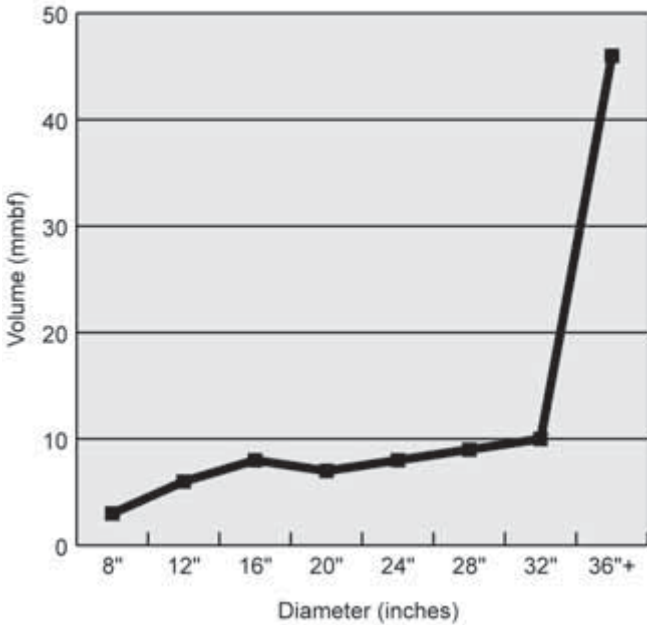
Prior to 1994, these same lands were allocated toward timber production. From 1945 to 1994, approximately 19,000 acres of harvest activity occurred on Federally- administered lands within the Elk Creek Watershed (USDA and USDI 1996, II-59).

Post-fire

The Timbered Rock Fire resulted in approximately 100 million board feet of standing fire-killed timber on BLM-administered lands. Estimated volume of fire-killed trees by diameter class are shown on Figure 3.17-1.

The potential for economic recovery of this volume would be reduced over time due to tree decay. Depending on size and tree condition, approximately 5 to 20 percent of board foot volume loss can occur in Douglas-fir from general deterioration in one year. Deterioration in relatively younger and smaller trees (30" DBH or less) is more rapid and can have 50 percent volume loss after 3 to 4 years. In older and larger trees (30" DBH or larger), 50 percent volume loss occurs in approximately 10 to 15 years (Kimmey and Furniss 1943, 53). Within the Timbered Rock Fire area, it is estimated trees less than 16" DBH would lose their economic value within 2 years. On BLM-administered lands, deterioration of all dead trees would result in approximately 20-30 million board feet of volume loss within two years.

Figure 3.17-1. Volume of Fire-killed Trees by Diameter Class



On private industrial forest lands, there are approximately 6,000 acres of merchantable timber land burned. The volume of fire killed timber is unknown but salvage activity on these lands are ongoing.

3.17.2.2 Restoration

Pre-fire

Pre-fire restoration activities within the watershed have included fuels reduction, fish habitat improvements, and plantation development. Plantations were the primary investments altered by the Timbered Rock Fire.

On BLM-administered lands, roughly 5,400 acres of developing plantations existed within the Elk Creek Watershed. Multiple activities, such as planting, pre-commercial thinning, and brushing, have occurred on these lands. These treatments have been ongoing and largely a result of past timber sale activity.

Post-fire

Approximately 1,700 acres of developing plantations were burned in the Timbered Rock fire, resulting in a lost investment estimated at about $900,000. Due to small average tree size and decay rates to the earliest time of harvest (1-2 years), these areas have minimal to no commercial value and no opportunity to recover investment losses through timber salvage.

Fire suppression operations costs were nearly $1 million dollars. An additional $3.4 million dollars in work is scheduled under the Timbered Rock Fire ESRP.

Rehabilitation and stabilization projects are ongoing and include reestablishment of burned plantations.

3.17.3 Environmental Consequences

Economic recovery of fire-killed trees and investments into restoration are the two primary management activities proposed that would have a measurable effect on the economy. Effects are compared by alternative and measured as revenue or cost to the Federal Treasury in dollars. The indicators used to measure effect on society are employment, employment income, and commodity output values. Employment levels, and resulting employment income, are based on the number of full-time jobs provided for one year (Full Time Equivalent or FTEs). Commodity output values would apply to the value of a processed product and its value in sales to the regional economy. The No-Action Alternative (Alternative A), serves as the baseline for comparing the net change in economic effects of the action alternatives. Estimates are for comparison purposes and may not reflect actual values.

3.17.3.1 Volume and Value of Timber Resources from Salvage

Direct and Indirect Effects

Salvage of fire-killed trees provides for revenue to the Federal Treasury through sale of the timber. Estimates of harvest volume and revenue by alternative are summarized in Table 3.17-1.

Table 3.17-1. Estimated Harvest Volume and Revenue to the Federal Treasury from Proposed Salvage

	Alternative						
	A	B	C	D	E	F	G
Harvest Volume (mmbf)	0	0	8.6	21.0	29.4	8.0	23.4
Revenue/ mbf	0	0	$225	$209	$184	$229	$204
Revenue (millions)	0	0	$1.9	$4.4	$5.4	$1.8	$4.8

NOTE: Figures are rounded.
mmbf = million board feet
mbf = thousand board feet

Extracting and processing a commodity generates employment, employment income, and product sale values for the regional economy. Direct employment figures are based on Table 3&4-49 in the Northwest Forest Plan FSEIS (USDA and USDI 1994a, 3&4-293). Resulting employment incomes are $32,469 per job and based on Oregon

Table 3.17-2. Estimated Direct and Indirect Employment and Employment Income from Proposed Salvage (millions of dollars)

	Alternative						
	A	B	C	D	E	F	G
Employment							
Direct (9.44 jobs/mmbf)	0	0	81	199	277	76	221
Indirect (Multiplier 1.6)	0	0	49	119	166	45	133
Total employment	**0**	**0**	**130**	**318**	**443**	**121**	**354**
Employment Income							
Direct ($32,469/job)	0	0	$2.6	$6.4	$9.0	$2.5	$7.2
Indirect (Multiplier 1.5)	0	0	$1.3	$3.2	$4.5	$1.2	$3.6
Total employment income	**0**	**0**	**$3.9**	**$9.6**	**$13.5**	**$3.7**	**$10.8**

NOTE: Figures are rounded.

Employment Department average weighted wage rates for lumber and wood products (2001). Indirect employment and employment income levels use a multiplier of 1.6 and 1.5 respectively (see Table 3.17-2) (Tauer 2003, pers. com.). Multipliers are generated from IMPLAN 1996 and indicate "how much one unit of change in a particular part of the economy will impact the total economy of a given area." (Ayre 2003). An employment multiplier of 1.6 means the addition of 1.0 job would lead to an additional 0.6 jobs in the region (Tauer 2003, pers. com.). Ayre (2003) notes several weaknesses with multipliers; however, they are used for this analysis to gauge the general economic effect of proposed treatments.

Product value is the processed value of the timber after purchase. Manufacturing costs at the mill are included. This value does not include profit or actual sales value but serves as a base indicator for dollars flowing through the economy. An output multiplier of 1.3 is used to estimate the additional indirect sales in the regional economy (Tauer 2003, pers. com.). Although timber quality (grade) is considered for base timber values, the actual sale values for processed lumber may be higher or lower than what is displayed in Table 3.17-3. This would be due to factors such as profit, market shifts, and variation in product values processed (i.e., dimension lumber versus moulding).

Effects of Alternatives A (No Action) and B on Volume and Value of Timber Resources from Salvage

Alternatives A and B would have no proposed timber salvage. Cutting of hazard trees which threaten life or property would occur under these alternatives, but salvage of those trees would require appropriate NEPA documentation.

Expected economic benefits from any hazard tree removal under Alternatives A and B would be minimal. It is more likely the cutting of some hazard trees would result in a cost for cutting with no value for salvage. Trees would be cut at the time workers are in an area and dead trees put them at risk. Many dead trees may not pose a current hazard but would become hazardous as they decay (see Safety 3.16). Delay in removal and continued decay would result in loss of economic value at varying levels or the loss of all trees (see Figure 3.17-2).

Trees less than one-third sound are considered unmerchantable. Due to decay, fire-killed trees 16" DBH or less would generally be unmerchantable after 2 years. After 5 years, trees less than 28" DBH have about 40 percent volume loss and only the largest trees are consistently salvageable. Due to reduced harvest efficiency, the potential for economic benefit from timber salvage would be lost within 3 years for areas where trees less than 28" are common. By year 3,

Figure 3.17-2. Estimated Volume Loss by Size Class

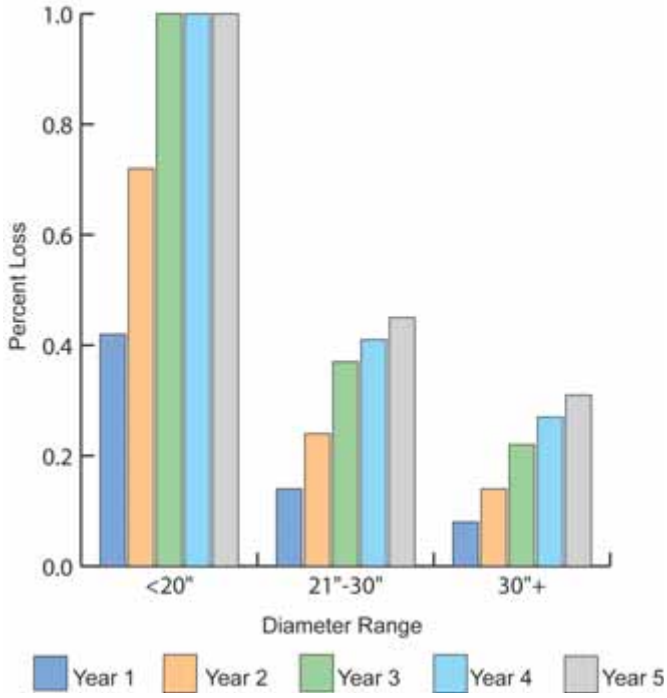


Table 3.17-3. Estimated Product Value

	Alternative						
	A	B	C	D	E	F	G
Product Sale Value @ $662/mbf	0	0	$5.7	$13.9	$19.4	$5.3	$15.5
Indirect Sale Value (multiplier 1.3)	0	0	$1.7	$4.2	$5.8	$1.6	$4.6
Total Dollars Generated in Sales	0	0	$7.4	$18.1	$25.2	$6.9	$20.1

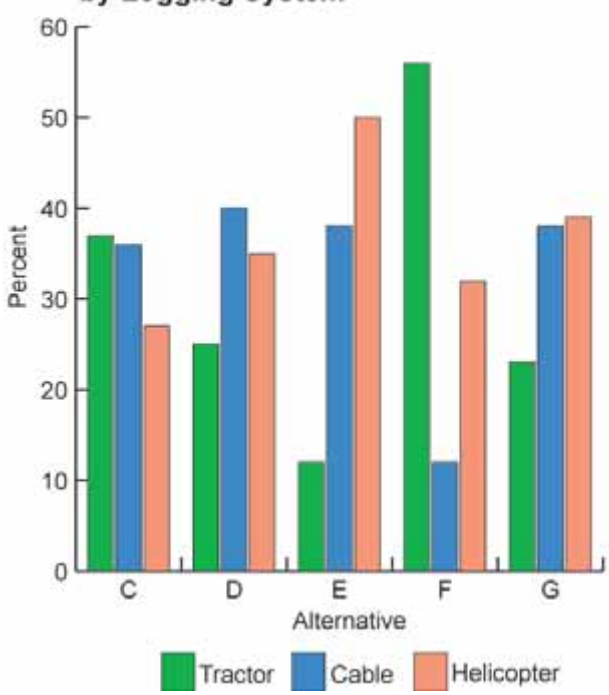
NOTE: Figures are rounded and are estimates for comparison purposes only and may not reflect actual values. Dollar values are in millions.

reassessment of these areas would be required to determine the feasibility of salvage. Areas of consistently larger trees (28" DBH or greater) could remain salvageable for 10 to 15 years, but volume losses from decay and drying would continue to occur.

Effects of Alternatives C, D, E, F, and G (Preferred Alternative) on Volume and Value of Timber Resources from Salvage

Alternatives D, E, and G would provide for higher total revenues and annual employment. Alternatives C and F would provide for higher levels of harvest efficiency (revenue/mbf to the Treasury). Alternative E would provide the highest level of revenue and employment as a simple function of harvesting more volume. Revenue per unit of harvest to the Treasury ($/mbf), however, would be greatest in Alternative F due to lower costs for removal.

Figure 3.17-3. Percent Volume Removal by Logging System



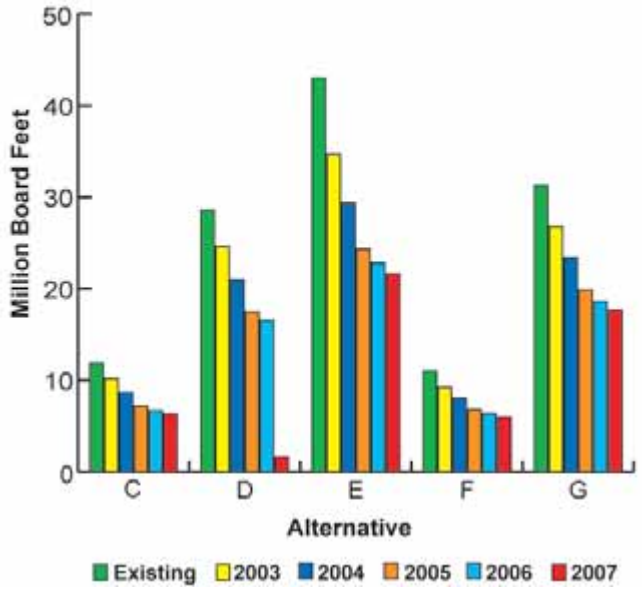
Given similar conditions, method of harvest is one of the primary factors affecting harvest cost. Helicopter logging generally incurs the highest cost for removal per thousand board feet. Cable logging tends to be a lower cost, with tractor logging having the least cost. Alternative F would provide a greater return per unit of harvest due to a higher proportion of volume being removed with tractor logging. Alternative E would provide the lowest level of return per unit of harvest due to a proportionately higher level of helicopter logging (Figure 3.17-3).

Comparing Table 3.17-1 (revenue/mbf) and Figure 3.17-3 illustrates the revenues to the Federal Treasury improve with higher harvest efficiency. Efficiency factors, such as additional road access, are not completely accounted for but would reduce harvest costs by providing shorter helicopter flight distances. Higher harvest costs could also result due to higher than expected levels of wood decay (lower volume and value per acre treated). These factors cannot be accurately assessed until an alternative is implemented and a more detailed appraisal can be made of available volume, decay condition, and associated harvest parameters of a given area.

Decay of standing dead trees would affect the amount of timber harvested and its value for all alternatives. Depending on the level of decay for a given area, harvest volume and revenue could be higher or lower than assessed in Tables 3.17-1 and 3.17-3. This is especially true with respect to helicopter yarding. The cost of helicopter yarding would increase with levels of decay because the same weight of material being yarded would provide a lower percentage of merchantability. At the time harvest would likely occur (2004), more than 20 percent of the existing volume would be decayed. Level of decay would continue to increase with time as shown in Figure 3.17-4.

In Alternative G, 535 acres of high and moderate burn severity area are included in proposed research units (see Appendix G, Research Proposal). Under the research proposal, 282 acres would be harvested resulting in about 7.4 million board feet. Implementing harvest as proposed under Alternative G area salvage guidelines on these same areas would result in 358 acres of salvageable area of which 280

Figure 3.17-4. Available Harvest Volume and Deterioration by Alternative



acres would be harvested. This would provide an estimated harvest level of 9.1 million board feet. The effect of reduced harvest levels (1.7 mmbf), as a result of implementing research, would be proportional to the effects on revenue and employment values shown in Tables 3.17-1 through 3.17-3.

3.17.3.2 Restoration

Direct and Indirect Effects

Restoration activities are a cost with the investment into resource values resulting in employment and employment income flowing through the economy. Restoration activities are listed in Chapter 2, Table 2-1. Table 3.17-4 provides a summary of estimated restoration costs and associated employment values by alternative.

Employment levels are derived from employment income and wages. A weighted average wage rate of $13.09/hour is used to determine total work hours from estimated employment income (Oregon Employment Department 2003). Employment level is determined based on 2,080 work hours as a full-time equivalent (full-time worker for 1 year). Direct employment income (labor costs) is assumed to be 46.8 percent of the total restoration cost. Multipliers of 1.6 and 1.5 are used for adding indirect employment and employment income values (Ayre 2003). Values listed for Alternative A reflect work already scheduled in the Timbered Rock ESRP (2002). Activity in the ESRP would occur in all alternatives but the values have been excluded from Alternatives B through G to display the added value of the alternative proposals.

The estimated values from Table 3.17-4 include costs for pre-commercial thinning and treatment of slash (pile and burn) which are a part of commercial thinning, pine release, and fuel management proposals. A combination of commercial and pre-commercial treatment would occur in Alternatives C, D, E, and G. These activities may occur in the same area but are separated to accurately distinguish revenue and employment resulting from each activity.

Tables 3.17-5 and 3.17-6 summarize the values for commercial thinning (density management) and pine release. The values provided are in addition to values for salvage.

Commercial timber harvest values would generate employment, employment income, and dollar flow through the economy as a result of extracting and processing a commodity. The value to the Federal Treasury, however, would have a small positive return for density management and incur a cost for pine release. This results from smaller, low value trees being harvested using high cost harvest methods. Adding the cost of pre-commercial thinning to commercial harvest values, results in an even higher actual cost for both activities. The net cost of pine release and density management increases by $560 to $760 per acre respectively when the costs of cutting unmerchantable trees, and piling and burning are added. The overall cost of

Table 3.17-4. Restoration Costs with Resulting Employment and Income Revenue (millions of dollars)

	Alternative						
	A	B	C	D	E	F	G
Total Restoration Costs	**$3.4**	**$5.2**	**$5.9**	**$5.9**	**$8.4**	**$2.8**	**$5.9**
Income Revenue							
Direct	$1.6	$2.4	$2.7	$2.7	$3.9	$1.3	$2.7
Indirect	$0.8	$1.2	$1.4	$1.4	$2.0	$0.7	$1.4
Total Employment Income	**$2.4**	**$3.6**	**$4.1**	**$4.1**	**$5.9**	**$2.0**	**$4.1**
Employment							
Direct	77	89	101	101	145	49	101
Indirect	46	53	60	60	87	29	60
Total Employment	**122**	**142**	**161**	**161**	**232**	**78**	**161**

Table 3.17-5. Estimated Values for Density Management

	Alternative		
	A, B, F	C, D, G	E
Harvest Volume (mmbf)	0	0.9	1.8
Revenue/mbf	0	$0.20	$7.20
Total Revenue	0	$160	$13,000
Employment			
Direct (9.44 jobs/mmbf)	0	9	17
Indirect (Multiplier 1.6)	0	5	10
Total employment	**0**	**14**	**27**
Employment income			
Direct ($32,469/job)	0	$286,000	$537,000
Indirect (Multiplier 1.5)	0	$143,000	$268,000
Total employment income	**0**	**$429,000**	**$805,000**
Sale Value			
Product ($484/mbf)	0	$451,000	$848,000
Indirect (Multiplier 1.3)	0	$135,000	$254,000
Total dollars generated in sales	**0**	**$586,000**	**$1,102,000**

accomplishing the restoration work, however, is generally less with commercial harvest than by implementing these activities without commercial removal (see Table 3.17-7). The harvest activity itself accomplishes some of the work and serves to offset the total treatment cost.

Due to low harvest values, the value to the Federal Treasury for density management and pine release would vary. Areas with low volume and high harvest costs, such as helicopter yarding, may not result in a cost savings with commercial harvest. As a result, not all areas would be treated commercially. Project proposals in Appendix E recognize this and describe a combination of commercial and pre-commercial treatments. Some areas treated commercially would provide a higher net benefit than shown. This would be offset by treatment of lower value areas where it is not cost effective for commercial harvest but commercial harvest provides for treatment objectives at lower cost than non-commercial treatment.

Cumulative Effects

All alternatives would add employment and employment income to the regional economy. Resulting economic values, from all activities, would have a relatively higher level of effect at the local level (county or region) with relative effect at the broader scale less evident (state or national).

Economic recovery of fire-killed timber would provide for revenue to the Federal Treasury as well as supply a commodity used by society. Restoration incurs a cost to the Treasury but generates employment and employment income to the regional economy. Table 3.17-8 summarizes dollar values and employment levels by Alternative for both salvage and restoration.

Alternative A includes approximately $3.4 million dollars requested for rehabilitation work under the Timbered Rock ESRP, 2002. Except for varying levels of reforestation, actions in the ESRP would be implemented in all alternatives. The values shown in Table 3.17-8 include costs that would be incurred through implementation of the ESRP.

The level of harvest would contribute to current and planned timber sales offered by the Medford District BLM. Currently, 84 million board feet of timber on the Medford District BLM has been sold but not yet harvested. Approximately 45 million board feet listed as sold, however, is on hold from harvest for an indefinite period of time. Planned sales for fiscal years 2003 and 2004 would total approximately 107 million board feet.

Table 3.17-6. Estimated Values for Pine Release

	Alternative		
	A, B, F	C, D, G	E
Harvest Volume (mmbf)	0	1.6	3.7
Revenue/mbf	0	($103)	($101)
Total Revenue	0	($160,000)	($375,000)
Employment			
Direct (9.44 jobs/mmbf)	0	15	35
Indirect (Multiplier 1.6)	0	9	21
Total employment	**0**	**24**	**56**
Employment income			
Direct ($32,469/job)	0	$476,000	$1,133,000
Indirect (Multiplier 1.5)	0	$238,000	$567,000
Total employment income	**0**	**$714,000**	**$1,700,000**
Sale Value			
Product sale value ($448/mbf)	0	$696,000	$1,657,000
Indirect sale value (Multiplier 1.3)	0	$209,000	$497,000
Total dollars generated in sales	**0**	**$905,000**	**$2,154,000**

Table 3.17-7. Cost Comparison of Commercial vs. Non-Commercial Treatment

	Alternative	
	C, D, G	E
Density Management		
With commercial harvest	$354,000	$653,000
Without commercial harvest	$363,000	$683,000
Net Savings	$9,000	$30,000
Pine Release		
With commercial harvest	$596,000	$1,410,000
Without commercial harvest	$606,000	$1,442,000
Net Savings	$10,000	$32,000

Salvage logging of private industrial forest lands in the Timbered Rock Fire area has been ongoing, and is expected to be complete in 2004. Harvest of BLM-administered lands would not begin until the spring of 2004. Considering local mill capacity, the potential supply of wood fiber to local mills, from BLM-administered lands, would not conflict with the supply from private lands within the Timbered Rock Fire area. At the regional scale, southwest Oregon experienced several large fires in 2002 with potential for salvage. Approximately 1.5 billion board feet of fire-killed timber is thought to exist outside of wilderness areas in the Biscuit Fire and fire areas within the Umpqua National Forest (USDA January 2003, 143-145; USDA March 2003, 27). The actual level of planned salvage from these areas is unknown, but there is the possibility for a large enough offering to exceed local mill capacities. A sudden large supply of Federal timber would affect interest and value in salvage material offered.

The likelihood of exceeding local mill capacity is not yet known. Federal timber sales with green tree volume, including the 45 million board feet currently on hold, could be postponed to alleviate supply levels. There is also a possibility of interest from mills outside Southwest Oregon. Inquiries about salvage in the Biscuit Fire have been made from Idaho, eastern Washington, and throughout Oregon (USDA January 2003, 145). This would increase the ability to utilize more of the salvage material, but level of interest would depend on market prices and quality of material. Decay of dead trees would play a primary factor in the quality of material.

Table 3.17-8. Net Value of Actions Considered

	Alternative						
	A	B	C	D	E	F	G
Harvest (mmbf)	--	--	11.1	23.5	34.9	8.0	25.9
Harvest-Related Revenue to the Treasury	--	--	$1.7	$4.2	$5.0	$1.8	$4.6
Restoration Costs to the Treasury	$3.4	$5.6	$6.3	$6.3	$8.9	$3.3	$6.3
Direct and Indirect Employment	122	154	341	529	770	211	565
Direct and Indirect Employment income	$2.4	$4.0	$9.5	$15.2	$22.2	$6.0	$16.4
Direct and Indirect Product Value ($ flow in sales)	--	--	$8.9	$19.6	$28.5	$6.9	$21.6

NOTE: Dollar values are in millions.
$431,928 of ESRP money added to Alternatives B-G.

3.18 Environmental Justice

Executive Order 12898 (*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,* February 11, 1994) requires that all federal agencies "make achieving Environmental Justice part of [their] mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."

Table 3.18-1 depicts the percent of people living in poverty within the area.

Table 3.18-1. All People in Poverty

Area	Percent
Oregon	11.6
Douglas County	13.1
Jackson County	12.5
Josephine County	15.0
SOURCE: 2000 Census	

Table 3.18-2 illustrates the population of the area by race and origin.

Based on experience with other projects in the Butte Falls Resource Area, none of the proposed actions would substantially affect minority or low-income individuals. Implementation of these projects is expected to provide job opportunities in communities such as Trail, Shady Cove, Eagle Point, White City, and Medford. These communities include minority and low income populations that may benefit from the economic effects. Small or minority-owned business would have the opportunity to compete for some of the work. Many of the reforestation companies hire from within minority groups. In addition, some of the small contractors who could bid on the proposed projects are re-trained forest workers.

3.19 Unavoidable, Irretrievable, and Irreversible Effects

3.19.1 Environmental Effects that cannot be Avoided

Implementing any alternative would result in some degree of environmental effects that cannot be avoided. While standards, guidelines, Best Management Practices (BMPs), and mitigation measures are intended to keep the extent and duration of these effects within acceptable levels, effects cannot be completely eliminated.

Although standards, guidelines, and BMPs are designed to prevent effects to soil and water, the potential for impacts does exist. Sediment could be produced by surface erosion and channel erosion.

Air quality would be affected by smoke from prescribed fires and burning of slash piles.

Ground-disturbing activities have the potential to temporarily increase sediment loads in some streams. Mitigation measures for ground-disturbing activities would include using existing skid trails, pulling slopes back to the natural slope when removing culverts, restricting mechanical operations to slopes less than 35 percent, water-barring skid

Table 3.18-2. Population by Race and Origin

		County		
	Oregon	Douglas	Jackson	Josephine
One Race				
White	2,961,623	94,234	166,125	71,103
Black or African American	55,662	177	724	202
American Indian and Alaska Native	45,211	1,530	1,980	949
Asian	101,350	628	1,631	476
Native Hawaiian and Other Pacific Islander	7,976	93	322	83
Some Other Race	144,832	1,025	5,218	883
Total (one race)	3,316,654	97,687	176,000	73,696
Two or More Races	104,745	2,712	5,269	2,030
Total	3,421,399	100,399	181,269	75,726
Hispanic or Latino (of any race)	275,314	3,283	12,126	3,229
SOURCE: 2000 Census				

trails during the same season as constructed, seeding and mulching decommissioned roads the same operational season they are decommissioned, placing fish structures during the instream work period, and limiting road renovation and/or improvement work to the dry season, generally May 15 to October 15.

3.19.2 Relationship between Short-Term Uses and Long-Term Productivity

Short-term use of the land includes day-to-day and even year-to-year activities that affect the landscape. It includes activities that remove resources from the land, such as fishing and hunting, as well as activities that do not, such as photography, site-seeing, and hiking. Short-term actions include management activities, such as vegetation management and harvest of fire-killed trees. As a renewable resource, trees and vegetation can reestablish and grow again if the productivity of the land is not impaired.

Maintaining the productivity of the land is a complex, long-term objective. All action alternatives protect the long-term productivity of the project area through the use of specific standards and guidelines, mitigation measures, and BMPs. Long-term productivity could change as a result of various management activities.

Soil and water are two key factors in ecosystem productivity, and these resources would be protected in all action alternatives to avoid damage that could take many decades to rectify. Timber, wildlife habitat, and other renewable resources all rely on maintaining long-term soil productivity. Quality and quantity of water from the project area may fluctuate as a result of short-term uses, but no long-term effects to the water resources are expected to occur as a result of the alternatives.