United States
Department of
Agriculture

Forest
Service

August 2004

Davis Fire Recovery Project

Final Environmental Impact Statement

Volume 1

Crescent Ranger District, Deschutes National Forest
Klamath and Deschutes Counties, Oregon

DAVIS FIRE RECOVERY PROJECT

Final Environmental Impact Statement

United States Department of Agriculture – Forest Service
Pacific Northwest Region – Deschutes National Forests

Lead Agency:	USDA Forest Service, Deschutes National Forest
Responsible Official:	Leslie Weldon Forest Supervisor Deschutes National Forest 1645 Hwy 20 East Bend, OR 97701
For Further Information Contact:	Chris Mickle, IDT Leader Crescent Ranger District PO Box 208 Crescent, OR 97733 (541)433-3200

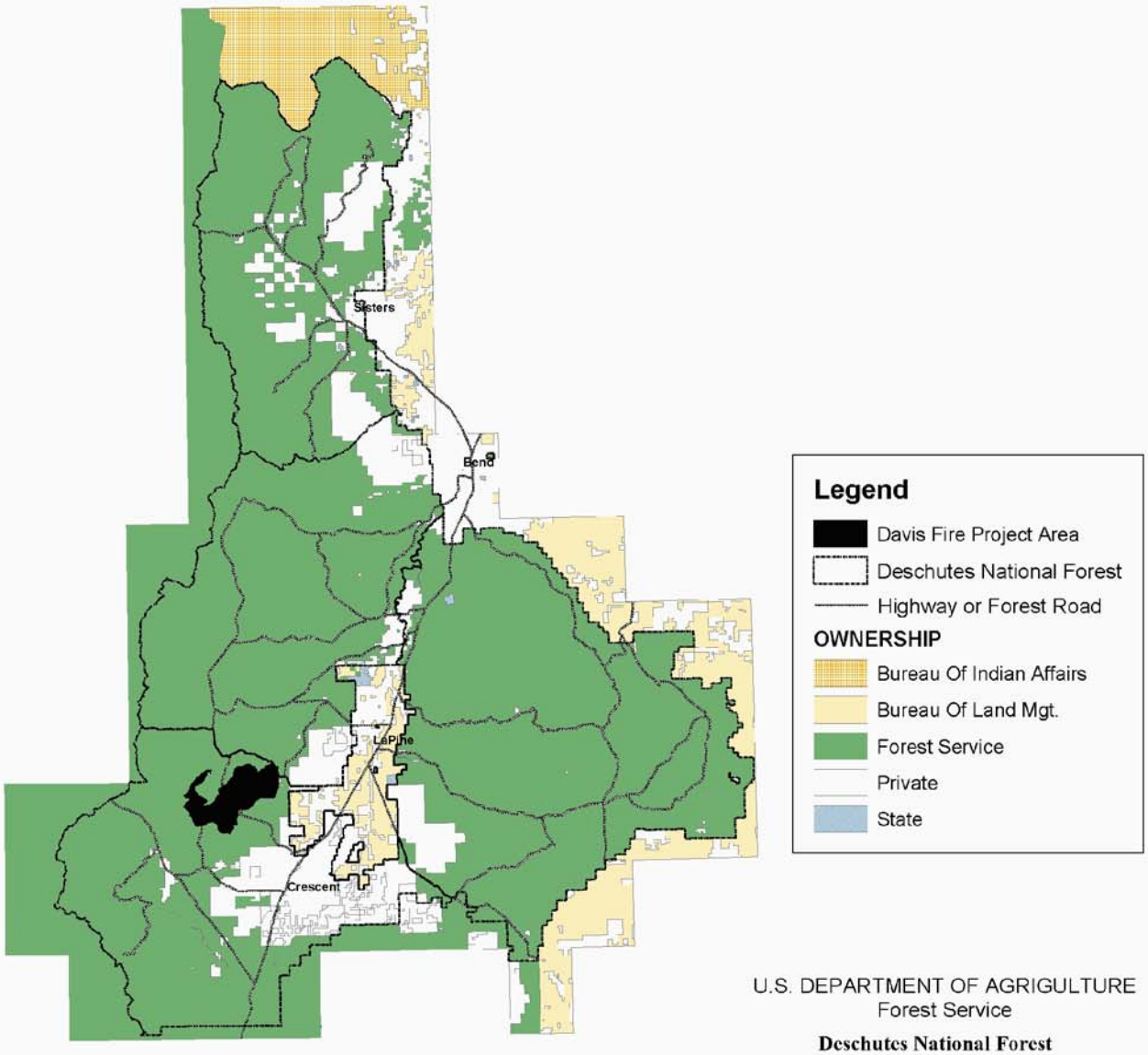
Abstract:

This Final Environmental Impact Statement (FEIS) describes the effects of implementing 5 alternatives for the recovery of National Forest System lands that burned in the Davis Fire of 2003 on the Deschutes National Forest in Central Oregon. The fire burned approximately 21,000 acres of National Forest on the Crescent Ranger District. The proposed projects are focused on moving resource conditions closer to the desired future conditions identified in the Davis Late Successional Reserve Assessment, the Northwest Forest Plan, and the Deschutes National Forest Land and Resource Management Plan.

The alternatives vary in the amount of salvage harvest that is proposed between 0 and 6355 acres. Fuels reduction and reforestation are included in varying amounts for each action alternative. Alternative B is the Forest Service's Preferred Alternative.

Emergency Situation Determination: The Forest Supervisor is in the process of seeking a determination from the Regional Forester that an emergency situation exists in the Davis Fire Recovery Project area pursuant to 36 CFR 215.10(b). This emergency situation exists because substantial loss of economic value to the Federal Government would occur if implementation of the decision were delayed. The final determination by the Regional Forester will be published in the Record of Decision, 36 CFR 215.10(d).

Map # 1 Vicinity Of Project Area

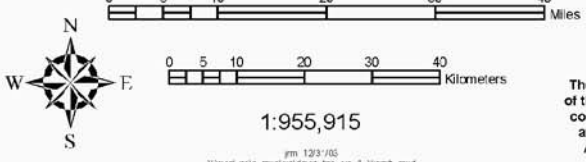


U.S. DEPARTMENT OF AGRIGULTURE
Forest Service

Deschutes National Forest

Crescent Ranger District

Davis Fire Recovery Project EIS



1:955,915

jrm 12/3/03
W:\davis\davis_fire_eis_1_Vicinity.mxd

The Forest Service cannot assure the reliability or suitability of this information for a particular purpose. Original data was compiled from various sources and is the most current data available. Spatial information may not meet National Map Accuracy Standards. This information may be updated, corrected, or otherwise modified without notification.

Table of Contents

Volume 1

CHAPTER 1 PURPOSE AND NEED 1-1

Introduction 1-1
Document Organization 1-1
Changes Between Draft EIS and Final EIS 1-2
Purpose and Need for Action 1-2
Background 1-2
Purpose and Need 1-5
Planning Framework 1-8
Local Assessments 1-13
Project Record 1-14
Scope of Project and Decision Framework 1-17

CHAPTER 2 ALTERNATIVES 1-19

Introduction 2-20
Changes Between Draft EIS and Final EIS 2-20
Scoping and Public Involvement 2-21
Identification of Issues 2-22
Key Issues 2-24
Analysis Issues 2-25
Alternative Descriptions 2-26
Alternative A 2-26
Actions and Design Elements Common to all Fully-Analyzed Action Alternatives 2-26
Forest Plan Amendment 2-28
Alternative B 2-30
Alternative C 2-31
Alternative D 2-32
Alternative E 2-33
Mitigation and Resource Protection Measures 2-34
Sale Area Improvement Projects 2-42
Comparison of Alternatives 2-43
Alternatives and Design Elements Considered but not Fully Analyzed 2-58

CHAPTER 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES 2-63

Introduction 3-63
Changes Between Draft EIS and Final EIS 3-66
Soils 3-64
Wildlife Habitat (Snags and Down Wood 3-100
Forested Vegetation 3-138
Fire and Fuels 3-171
Wildlife 3-191
Threatened and Endangered Species 3-191
Regional Forester's Sensitive Species 3-224
Survey And Manage Species 3-232
Management Indicator Species 3-238
Birds of Conservation Concern 3-242
Big Game - Deer and Elk 3-245
Fisheries 3-252
Water Quality 3-296
Botany 3-318

Noxious Weeds 3-325
Cultural Resources 3-335
Recreation 3-339
Unroaded Areas 3-343
Scenery Resources 3-346
Economic and Social Analysis 3-353
Air Quality 3-372
Other Disclosures 3-376
Forest Plan Amendment 3-376
Short-term Uses and Long-term Productivity 3-376
Unavoidable Adverse Effects 3-377
Irreversible and Irretrievable Commitment of Resources 3-377
Incomplete and Unavailable Information 3-378
Consistency with the Clean Water Act 3-378
Northwest Forest Plan LSR Standards and Guidelines 3-380
Regional Forester's East Screens 3-385
Davis Lake Special Interest Area 3-388

Volume 2

CHAPTER 4 CONSULTATION AND COORDINATION 4-1

Preparers 4-2
List of Agencies, Organizations, and Individuals to whom the DEIS, Summary or Web Availability Notification was Sent 4-5
Literature Cited 4-7
Glossary 4-19
Index 4-43

APPENDICES

Appendix A – Alternative Tables, Units and Prescriptions
Appendix B – Soil Resource Unit Summaries
Appendix C – Response to Beschta
Appendix D – Determining Snag Retention
Appendix E – Response to Comments
Appendix F – Regional Ecosystem Office Review and Concurrence
Appendix G – Summary of Late Successional Reserve Management Strategy Areas
Appendix H – 2004 Wildlife Survey Results

List of Tables

Table 2.1 Crescent Ranger District's NEPA Mailing List, September 8, 2003 2-22
Table 2.2 Alternative B Summary 2-30
Table 2.3 Alternative C Summary 2-31
Table 2.4 Alternative D Summary 2-32
Table 2.5 Alternative E Summary 2-33
Table 2.6 Comparison of the Activities by Alternative 2-43
Table 2.7 Comparison of How Each Alternative Responds to the Purpose and Need 2-44
Table 2.8 Comparison of the Alternatives Based on How Each Responds to the Key Issues 2-48
Table 3.1 Past Harvest Activity and Existing Detrimental Conditions within Subwatersheds Containing Perennial Streams 3-70
Table 3.2 Existing Detrimental Disturbance within Proposed Activity Units 3-71

Table 3.3 Fire Severity and Extent within Subwatersheds 3-73
Table 3.4 Predicted Pre- and Post-fire Annual Upland Erosion Losses on 20% Slopes by Storm Type 3-80
Table 3.5 Predicted Pre and Post-fire Annual Upland Erosion Losses on 5% Slopes by Storm Type 3-81
Table 3.6 Predicted First Year Changes in Sediment Yields to Stream Courses from within Burned Area 3-82
Table 3.7 Estimated Above Ground Nutrient Losses within Stand 3-85
Table 3.8 Alternative B Logging System Unit Acres by Subwatershed 3-88
Table 3.9 Alternative B Predicted Detrimental Acres from Proposed Harvest Activities 3-90
Table 3.10 Alternative B Nutrient Removal from Proposed Harvest within Stand Replacement Activity Units 3-93
Table 3.11 Snag Retention for Harvest Units 3-102
Table 3.12 Species with Dead Wood or Fire-created Habitat as a Primary Habitat Feature 3-104
Table 3.13 Pre-Fire Structural Stages in Project Area 3-105
Table 3.14 Post Fire Structural Stage across Davis Fire Area 3-106
Table 3.15 Pre-harvest Snag Data from Timber Sales, Ponderosa Habitats 3-108
Table 3.16 Tolerance Levels for White-Headed Woodpecker 3-108
Table 3.17 Pre-harvest Snag Data from Timber Sales in Mixed Conifer Habitats 3-109
Table 3.18 Tolerance Levels for Pileated Woodpecker 3-109
Table 3.19 Pre-harvest snag levels in timber sales in Mixed Conifer and Ponderosa pine/ Douglas-fir 3-111
Table 3.20 Tolerance Levels for American Marten 3-112
Table 3.21 Acres of Habitat by Tolerance Level by Species 3-114
Table 3.22 Acres of Habitat of all Habitat Types by Tolerance Level by Species 3-116
Table 3.23 Post Harvest Acres of Habitat by Tolerance Level by Species 3-117
Table 3.24 Post Harvest Acres of Habitat by Tolerance Level by Species 3-118
Table 3.25 Post Harvest Acres of Habitat in All Habitat Types by Tolerance Level, Alternative A 3-124
Table 3.26 Post Harvest Acres of Habitat in All Habitat Types by Tolerance Level, Alternatives B and C 3-126
Table 3.27 Post Harvest Acres of Habitat in All Habitat Types by Tolerance Level 3-127
Table 3.28 Post Harvest Acres of Habitat in All Habitat Types by Tolerance Level 3-128
Table 3.29 Acres of Habitat by Tolerance Level and Species, Alternative A 3-129
Table 3.30 Acres of Habitat by Tolerance Level and Species , Alternative B 3-129
Table 3.31 Acres of Habitat by Tolerance level and Species, Alternative C 3-130
Table 3.32 Acres of Habitat by Tolerance Level by Species, Alternative D 3-130
Table 3.33 Acres of Habitat by Tolerance Level by Species Alternative E 3-131
Table 3.34 Alternative Comparison of Haggard and Gaines' Snag Density Categories 3-135
Table 3.35 Amount of Salvage Harvest and Reforestation by Alternative 3-136
Table 3.36 Post-Harvest Comparison of Alternative by Species Using DecAID Tolerance Levels 3-137
Table 3.37 Plant Association Group and Fire Intensity (Acres) 3-140
Table 3.38 Description of Structural Stages 3-141
Table 3.39 Post-Fire Seral-Structural Stages by Plant Association Group Compared to District-wide Historic Range of Variability 3-142
Table 3.40 Prescriptions by Management Strategy Areas 3-151
Table 3.41 Comparison of Effects for LSR and Non-LSR stands in Alternative D 3-161
Table 3.42 Fire Regimes 3-172
Table 3.43 Condition Classes within the Davis Fire Recovery Project Area 3-173
Table 3.44 Estimated Percent Departure from Historic Reference Conditions and Condition Class 3-176
Table 3.45 Summary of Fuels Inventory Listed by Stands Samples 3-178
Table 3.46 High and Extreme Resistance to Control Ratings Based on Loadings in Tons per Acre 3-181
Table 3.47 Biomass Projections for Untreated Stands 3-186
Table 3.48 Biomass Projections for Treated Units 3-189
Table 3.49 Amount of Project Area with Fuel Loading not Exceeding 10-35 Tons Per Acre 3-190
Table 3.50 Threatened and Endangered Species Summary 3-191
Table 3.51 Summary of Conclusion of Effects, Threatened and Endangered Species 3-191
Table 3.52 Bald Eagle Nest Territories and Yearly Status 3-193
Table 3.53 Wickiup BEMAs Baseline Acres, Loss from Fire, Loss from Suppression 3-194
Table 3.54 Davis BEMAs Baseline Acres, Loss from Fire, Loss from Suppression 3-194
Table 3.55 Stand Characteristics with No Planting modeled by Forest Vegetation Simulator (FVS) 3-197
Table 3.56 Stand Characteristics over Time with Planting (FVS) (Ponderosa Pine, Douglas-fir) 3-197

Table 3.57 Comparison of Effects to BEMAs by Alternative 3-200
Table 3.58 Spotted Owl NRF Habitat by Allocation 3-203
Table 3.59 Dispersal Habitat Definition 3-203
Table 3.60 Status of Owl Home Ranges 3-204
Table 3.61 Baseline Acres of NRF, Loss from Fire, Loss from Suppression 3-205
Table 3.62 Home Range NRF Baseline, Loss from Fire, Loss from Suppression 3-205
Table 3.63 Stand Development with No Planting 3-210
Table 3.64 NRF in Fuels Units 3-211
Table 3.65 Acres of Harvest or Fuels Treatments within Owl Territories 3-211
Table 3.66 Stand Development Over Time with Planting (Ponderosa pine/Douglas-fir) 3-212
Table 3.67 Acres of Stand Replacement Fire by NWFP Allocation (No Treatments) 3-213
Table 3.68 Dispersal Habitat in Moderate and High Intensity Area Over Time (No Treatments) 3-213
Table 3.69 Snag Habitat over Time, Mixed Conifer – Alternative A 3-214
Table 3.70 Treatments by Northwest Forest Plan Allocation under Alternatives B and C 3-215
Table 3.71 Dispersal Habitat in Moderate and High Intensity 3-215
Table 3.72 Snag Habitat over time – Alternative B and C (LSR, Mixed Conifer) 3-216
Table 3.73 Alternative D Treatments within Northwest Forest Plan Allocations 3-217
Table 3.74 Dispersal Habitat in Moderate and High Intensity 3-217
Table 3.75 Snag Habitat over Time – Alternative D 3-218
Table 3.76 Treatments by Northwest Forest Plan Allocations Under Alternative E 3-219
Table 3.77 Dispersal Habitat in Moderate and High Intensity Alternatives E 3-219
Table 3.78 Snag Habitat Over Time – Alternative E 3-220
Table 3.79 NRF Distribution Across Davis Fire Recovery Project Area Before and After Davis Fire 3-221
Table 3.80 Changes in Spotted Owl Baseline Habitat 3-223
Table 3.81 Sensitive Species Summary 3-225
Table 3.82 Summary of Conclusion of Effects, Pacific Northwest Region Sensitive Species 3-226
Table 3.83 Harvest within Potential 3-236
Table 3.84 Migratory Focal Species 3-243
Table 3.85 Big Game Cover and Forage Across Project Area and Key Elk Area 3-247
Table 3.86 Harvest by Alternative 3-248
Table 3.87 Reforestation by Alternative 3-249
Table 3.88 Big Game Forage and Cover in 6th Field Watersheds 3-250
Table 3.89 Post-fire Cover Distribution in the Project Area 3-250
Table 3.90 Cover Distribution by Watershed Resulting from Reforestation Activities, in Acres 3-250
Table 3.91 Hiding Cover Development Over Time by Alternative 3-251
Table 3.92 Cover Development within the Key Elk Area 3-251
Table 3.93 Bodies of Water within the Davis Fire Recovery Project Area and Fish Species Utilizing Them 3-253
Table 3.94 Rosgen Stream Class Type by Reach for Streams within the Project Area 3-255
Table 3.95 Changes in Trapper Creek Channel Pattern and Profile Following Rehabilitation 3-257
Table 3.96 Changes to Bull Trout Habitat in Trapper Creek Following Rehabilitation Efforts 3-258
Table 3.97 Environmental Baseline of Relevant Indicators, Odell Lake Subwatershed for Bull Trout 3-261
Table 3.98 Maximum, Minimum, and Mean 1998 Summer Temperatures near the Outlet of Odell Lake (Upper) and at the Footbridge above Davis Lake (Lower) 3-262
Table 3.99 Tributary and Side Channel Influences on the Temperature of Crescent Creek 3-264
Table 3.100 Estimated Percent Substrate within the Wetted Main Channel Odell Creek 3-267
Table 3.101 Substrate Percentages from Pebble Counts within the Bankfull Channel of Selected Riffles 3-267
Table 3.102 Pool Attributes in Reaches 1-3 of Odell Creek 3-275
Table 3.103 Wood Volume in Odell Creek 3-275
Table 3.104 Woody Debris Abundance within Bankfull Channel of Crescent Creek 3-275
Table 3.105 Pool Attributes in Reaches 1-2 of Ranger Creek 3-276
Table 3.106 Pool Attributes Crescent Creek 3-277
Table 3.107 Side Channel Attributes of Crescent Creek on Forest Service Administered Lands 3-278
Table 3.108. Overall reach characteristics for Crescent Creek between FS Road 61 and Crescent Lake. 3-280
Table 3.109 Crescent Creek Channel Attributes 3-281
Table 3.110 Odell Creek Discharge in CFS for Indicated Recurrence Interval in Years and Annual Exceedance Probability in Percent 3-284

Table 3.111 Open Road Density by Subwatershed – Common to All Action Alternatives 3-286
Table 3.112 Sixth Field Watersheds Affected by Davis Fire 3-288
Table 3.113 Past Harvest Activity and Existing Detrimental Soil Conditions within Odell Creek and Davis Lake Subwatersheds 3-288
Table 3.114 Proposed Harvest by Subwatershed 3-289
Table 3.115 Odell Creek Discharge in CFS for Indicated Recurrence Interval in Years and Annual Exceedance Probability in Percent 3-292
Table 3.116 Summary of Effects Determination for Threatened, Endangered, and Sensitive Fish Species ... 3-293
Table 3.117 Aquatics Projects Project Design Criteria Compliance Checklist 3-294
Table 3.118 Area of Subwatersheds within the Fire Perimeter 3-296
Table 3.119 Acres of Stand Replacement Fire Intensity and Stream Density by Subwatershed 3-298
Table 3.120 Road Density in Subwatersheds that have Streams within Fire Perimeter 3-300
Table 3.121 Percent Equivalent Clearcut Acres for Stream-Bearing Watersheds 3-301
Table 3.122 Percent of Aquatic Influence Zones occupied by Roads within Subwatersheds that have Road/Stream Crossings 3-303
Table 3.123 Summary of Fire Suppression Activities on Davis Fire, 2003 3-308
Table 3.124 Plant Prefield Review 3-319
Table 3.125 Survey and Manage Prefield Review 3-321
Table 3.126 Summary of Conclusions of Effects for Sensitive Plant Species 3-322
Table 3.127 Noxious Weed Comparative Risk Assessment 3-334
Table 3.128 Scenery 3-347
Table 3.129 Central Oregon Population Growth 3-353
Table 3.130 Average Annual Wages in Central Oregon 1990 – 1999 3-355
Table 3.131 Comparison of Volumes by Alternatives in Hundreds of Cubic Feet (CCF) 3-359
Table 3.132 Alternative Estimated Volumes CCF by Species 3-361
Table 3.133 Forest Service General Costs 3-361
Table 3.134 Logging Cost per ccf by Logging System and Alternative 3-362
Table 3.135 Post Harvest Treatment Costs 3-363
Table 3.136 Alternative Financial Efficiency Salvage Units Only 3-364
Table 3.137 Alternative Financial Efficiency Including Restoration Outside Salvage Units 3-365
Table 3.138 Non-timber Related Projects 3-365
Table 3.139 Long Term Management Scenario by Alternative 3-366
Table 3.140 Long Term Volumes by Alternative 3-370
Table 3.141 Estimated Smoke Emissions for Fuel Treatments 3-373
Table 3.142 Smoke Emissions by Alternative 3-373
Table 3.143 Treatment Acres and Within Davis Lake Special Interest Area by Alternative and Activity 3-388

List of Figures

Figure 1.1 Fire in Lodgepole, near East Davis Lake Campground 1-2
Figure 1.2 Burned Area of Davis Mountain 1-3
Figure 1.3 Ponderosa Pine Stand Near the East Shore of Davis Lake 1-3
Figure 1.4 Distribution of Davis Fire by Management Area 1-11
Figure 1.5 Distribution of Davis Fire area by Northwest Forest PlanAllocation 1-12
Figure 3.1 Inherent Soil Productivity Across Project Area 3-66
Figure 3.2 Snag Densities in Ponderosa Pine Habitat Over Time, Alternative A 3-114
Figure 3.3 Snag Densities in Ponderosa Pine Habitat Over Time, Alternatives B and C 3-115
Figure 3.4 Snag Densities in Ponderosa Pine Habitat over Time, Alternative D 3-117
Figure 3.5 Snag Densities in Ponderosa Pine Habitat Over Time, Alternative E 3-118
Figure 3.6 Snag Densities in Mixed Conifer Habitat over Time, Alternative A 3-120
Figure 3.7 Snag Densities in Mixed Conifer Habitat over Time, Alternatives B and C 3-121
Figure 3.8 Snag Densities in Mixed Conifer Habitat over Time, Alternative D 3-122
Figure 3.9 Snag Densities in Mixed Conifer Habitat Over Time, Alternative E 3-123
Figure 3.10 Lodgepole Snag Densities in the Project Area Over Time, Alternative A 3-125
Figure 3.11 Snag Densities in the Project Area over Time, Alternatives B and C 3-127

Figure 3.12 Mixed Conifer Habitat Distribution of Snags 10" dbh and Greater, Post-Harvest 2006 and 2046 3-133
Figure 3.13 Mixed Conifer Habitat Post Harvest Snags 20" dbh and Greater, 2006 and 2046 3-134
Figure 3.14 Percent of Project Area within the "Ideal" Category by Alternative 3-135
Figure 3.15 Management Strategy Areas of the Davis Late Successional Reserve 3-150
Figure 3.16 Fire Regime Group Composition 3-172
Figure 3.17 Down Fuel Loading in Tons per Acre by PAG, Burn Intensity, and Size Class 3-179
Figure 3.19 Projected Total Surface Fuel Loading, Salvage and Fuel Treatments Alts B, C, D, and E 3-188
Figure 3.20 Location of Bald Eagle Management Areas and Eagle Territories in and Adjacent to Davis Fire 3-195
Figure 3.22 Location of Davis Key Elk Area 3-246
Figure 3.23 Cover/Forage In Project Area Before and After Fire 3-247
Figure 3.24 Cover/Forage in Key Elk Area Before and After Fire 3-247
Figure 3.25 Number of Observed Redband Redds in Odell Creek (Wise, ODFW 2004) 3-260
Figure 3.26 Median Channel Temperature Versus River Mile for Crescent Creek with Tributaries Denoted with Red Dots and Side Channels Denoted by Green Dots. Direction of Flow is from Right to Left. 3-263
Figure 3.27 Burned Lodgepole Pine in Reach 1 of Odell Creek, October 2, 2003. 3-283
Figure 3.30 Snag Fall Down Rates 3-381

List of Maps

Map #1 Vicinity of Project Area ....
Map #2 Davis Fire Intensity and Northwest Forest Plan Allocations 1-7
Map #3 Deschutes Forest Plan Management Areas 1-15
Map #4 Northwest Forest Plan Allocations 1-16
Map #5 Project Area with Landmarks 1-18
Map #6 Alternative B – Salvage and Fuels-only Treatments 2-50
Map #7 Alternative B – Reforestation 2-51
Map #8 Alternative C – Salvage and Fuels-only Treatments 2-52
Map #9 Alternative C – Reforestation 2-53
Map #10 Alternative D – Salvage and Fuels-only Treatments 2-54
Map #11 Alternative D – Reforestation 2-55
Map #12 Alternative E – Salvage and Fuels-only Treatments 2-56
Map #13 Alternative D – Reforestation 2-57
Map #14 Soil Types 3-75
Map #15 Vegetation (Plant Association Groups) 3-143
Map #16 Post-Fire Structural Stage 3-144
Map #17 Fire Regimes 3-174
Map #18 Late Successional Reserves, Owl Home Ranges, and NRF Habitat 3-209
Map #19 Hydrology 3-299

Chapter 1

Purpose and Need

CHAPTER 1 – PURPOSE AND NEED

Introduction

The Forest Service has prepared this Final Environmental Impact Statement for the proposed forest restoration, salvage of fire-killed trees, and fuels reduction within the Davis Fire perimeter. This FEIS addresses the proposed action and 4 alternatives, including no action; the major issues associated with the proposal; and the direct, indirect, and cumulative effects of implementation of any of the alternatives.

Legal Location

The legal location for the Davis Fire Recovery Project area is described below:

- **Deschutes County**
  Township 22 South, Range 7 East, Sections 25-27, 34, 35
  Township 22 South, Range 8 East, Sections 21-29, 31-36, Willamette Meridian.
- **Klamath County**
  Township 23 South, Range 7 East, Sections 1-4, 9-16, 22-25
  Township 23 South, Range 8 East, Sections 1-12, 16-20, 29, 30, Willamette Meridian.

Document Organization

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

Chapter 1. Purpose and Need for Action: The chapter includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need.

Chapter 2. Alternatives, including the Proposed Action: This section details how the Forest Service informed the public of the proposal and how the public responded. This chapter provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes mitigation measures. Finally, this section provides a summary table of the environmental consequences associated with each alternative.

Chapter 3. Affected Environment and Environmental Consequences: This chapter describes the affected environment, the current conditions of the resources involved, and the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by resource area.

Chapter 4. Consultation and Coordination: This chapter provides a list of preparers and agencies consulted during the development of the environmental impact statement. This section also provides a glossary of terms, literature cited, and index.

Appendices (A – H): The appendices provide more detailed information to support the analyses presented in the environmental impact statement. Appendices E, F, G, and H were added between the Draft and Final EIS.

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

Changes Between the Draft EIS and the Final EIS

Within Chapter 1, only minor edits have been made for the Final EIS.

Purpose and Need for Action

Background

The Davis Fire area is located 10 miles west of LaPine, Oregon. The fire started on June 28, 2003 south of West Davis Campground. The fire was determined to be human-caused and the case remains open. It started in an area of heavy dead and down fuels in lodgepole pine and bitterbrush. The area where the fire began was the focus of recent planning efforts to conduct salvage of dead/down lodgepole, primarily for the purpose of reducing fuels and reducing the risk of high-intensity fire; however, the project had not been implemented.

Weather conditions quickly compounded the extreme fire conditions; the fire displayed characteristics that were likely outside of normal occurrences. On the second day, the fire became plume dominated, burning through the crowns of the trees and spreading to the northeast. The fire also spread to the northwest and around Davis Lake. That day the fire grew from 1,500 acres to about 15,000 acres.

Figure 1.1 Fire in Lodgepole, near East Davis Lake Campground

The fire spread rapidly and burned approximately 21,000 acres of National Forest System lands before it was reported contained on July 6, 2003. A large percentage of the fire was intense enough to kill either the majority of trees in a stand or the entire stand. Post-fire satellite imagery was analyzed to identify areas of low, moderate, and

high intensity burn. About 15,604 acres were of high or moderate intensity, resulting in complete mortality. Most of the highest impact occurred in the mixed conifer stands (nearly 11,900 acres of high/moderate intensity fire), and most of that was located within the Davis Late Successional Reserve (LSR). The high intensity burn covers most of the broad central portion of the fire area, shown in red on map #2, with very little left unburned. A few areas in the interior and more along the edges of the fire perimeter experienced more mixed intensities.

The picture to the right shows an area of mixed conifer on Davis Mountain where high intensity fire in the foreground left no needles on the trees; moderate intensity in the background left only brown needles; and a patch of low intensity fire in the upper left corner that was a young plantation. High intensity burn areas are considered 100% mortality and revert to stand initiation stage. Within moderate intensity burn areas the same is considered true except for the ponderosa pine vegetation type where there were large trees in the overstory that may survive. Low burn intensity areas experienced relatively low tree mortality with 0 – 20% mortality in the pines and Douglas-fir, and higher mortalities for the other species.

Figure 1.2 Burned area of Davis Mountain

The majority of the burn area was forested with dry mixed conifer stands comprised of ponderosa overstories with Douglas-fir in many areas. Sugar pine, western white pine, and white fir/Shasta fir were present in the overstory in some portions of the fire area. Understories consisted of white fir, lodgepole pine, and some of the other species in the mixed conifer areas, lodgepole pine and ponderosa pine in the ponderosa stands, and lodgepole pine with occasional other species in the lodgepole pine stands. Areas that had not already been thinned recently had high to very high stocking levels. Thinned areas were just below recommended maximum stocking levels. The majority of stands were being managed towards multi-storied stand structures for the northern spotted owl; untreated stands were highly multi-storied, with overtopped and interlocking crowns.

Figure 1.3 Ponderosa Pine Stand Near the East Shore of Davis Lake

Stand replacement fire occurred across all vegetation types. In ponderosa pine stands, which

historically would have experienced ground fire with individual or small group tree torching, there was complete mortality. In mixed conifer stands, which historically would have experienced a combination of fire effects with some stand replacement, there were thousands of acres of stand replacement. Inside the fire, 81% of the lodgepole pine stands experienced almost total mortality. The other 19% that experienced low intensity fire are also expected to die because of a low tolerance to fire. Young stands of sapling size which are lacking ground fuels may have survived the fire, but do not provide a seed source. The mixed conifer and ponderosa stands have no available seed source left because the fire occurred early in the season before seed had been allowed to mature and become viable within the cones. A majority of seed source present on the ground was killed as the duff layer was consumed.

Over half of the standing dead trees are expected to fall within 10 – 15 years, creating fuel beds far in excess of those that would have occurred under historic fire regimes in mixed conifer and ponderosa pine stands and above those recommended by the Late Successional Reserve Assessment.

Late Successional Reserve

About 56% of the fire occurred within the Davis Late Successional Reserve (LSR). According to the Northwest Forest Plan "The objective of Late-Successional Reserves is to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth related species including the northern spotted owl." (NWFP ROD, C-9)

Prior to the fire, management within the area was following objectives in the Northwest Forest Plan and the Davis LSR Assessment. The Davis LSR Assessment identifies desired conditions and management strategy for the LSR designed to protect and enhance a composition of six types of late-successional forest habitats (Davis LSRA, p 3-1). Within the fire area, the predominate type of late-successional forest habitat was mixed conifer for the northern spotted owl where the objective was to reduce the imminent susceptibility of habitat loss while maintaining the highest quantity and quality of climatic-climax habitat as possible in the short and long term.

Matrix

The part of the Davis Fire in the Matrix land allocation, located mostly around the north and east sides of Davis Mountain, and the top of Hamner Butte, burned in a different pattern than the largest part of the fire. The vegetation types are predominantly ponderosa pine dry and mixed conifer dry, with some lodgepole and mountain hemlock occurring on Hamner Butte. Much of the fire in these areas was the result of burnout operations for fireline control that resulted in lower intensity fire. As Map 2 shows, Hamner Butte and the north side of Davis Mountain had more low and moderate intensity fire compared to the broad swath of high intensity, plume-dominated fire that ran between the buttes.

In the fire area, Matrix lands provided connectivity from north to south between patches of suitable habitat. Connectivity has been lost to the fire. However, the Matrix lands that remain green currently provide a refuge for species associated with late and old structured forest habitat.

The underlying Deschutes Forest Plan management areas include Scenic Views, General Forest, and Bald Eagle.

Administratively Withdrawn

The Davis Lake Special Interest Area is Administratively Withdrawn under the NWFP. Approximately 1,020 acres of this allocation are within the fire perimeter (5% of fire area) and includes primarily the shoreline of Davis Lake. The burn intensity is mostly low in the meadow surrounding Davis Lake, and moderate and high intensity in the lodgepole stands to the south of the lake. This land allocation also includes a small amount of ponderosa pine vegetation type on the west side of Davis Lake that burned at a high intensity.

Outside the Northwest Forest Plan

Nine percent of the fire (about 1,735 acres) burned outside the Northwest Forest Plan area. This eastern end of the fire experienced mostly moderate intensity fire with patches of high and low intensity. The area is divided between Bald Eagle Management, General Forest, and Scenic Views by the Deschutes Forest Plan.

Purpose and Need

There is a need to move the project area towards desired conditions following the loss of late and old forest structure to the high and moderate intensity burn areas of the Davis Fire. The requirements for habitat recovery are specific to the vegetation type and guided by the respective land allocation.

There is a need to protect remaining late and old structured habitat within the LSR and the Matrix from future uncharacteristically severe fire.

- Increase suppression effectiveness and reduce the potential risk of high severity fire effects associated with subsequent fires.
- Protect the Matrix lands that have increased in importance on the landscape for providing a refuge for species associated with late and old structured stands.
- Protect remaining suitable habitat within the LSR by reducing fuels within and around the fire perimeter.
- Protect live forest from fire spreading from developed campgrounds and from Highway 46 by reducing fuels around these areas.
- Promote the long-term survival and growth of new conifers by bringing fuel loads to a sustainable level for eastside forests that reduces the likelihood of stand-replacement fire in newly regenerated stands, particularly during the early stages of stand development.

There is a need to establish fuel conditions that will allow for future management actions and restore fire as an ecosystem component.

- Bring fuel loads to a level that allows reintroduction of fire at the appropriate stages for the vegetation type.
- Large ponderosa pine trees are a desired component in the project area, particularly within the Bald Eagle Management Areas and large Douglas-fir are desired for spotted owls. Reestablishment and restoration of large tree habitat in the future will require the use of prescribed fire. The amount of surface fuels needs to be reduced so that prescribed fire can be used.
- Forest stands within the Davis Fire area were overly dense where they had not been recently managed by thinning. The amount and density of burned trees would limit active management of regenerated stands. Most of the trees will have fallen and become surface fuels by the time regenerated stands will be ready to be thinned. These fuels will pose a risk to regenerated forest and will limit our ability to use prescribed fire. Removing a portion of the dead trees now will also facilitate thinning the new stands, which accelerates growth and vigor of the trees.

There is a need to accelerate reforestation of the desired species in areas where no seed source remains and to provide habitat to species associated with late and old structured forests to meet objectives of the Davis Late Successional Reserve.

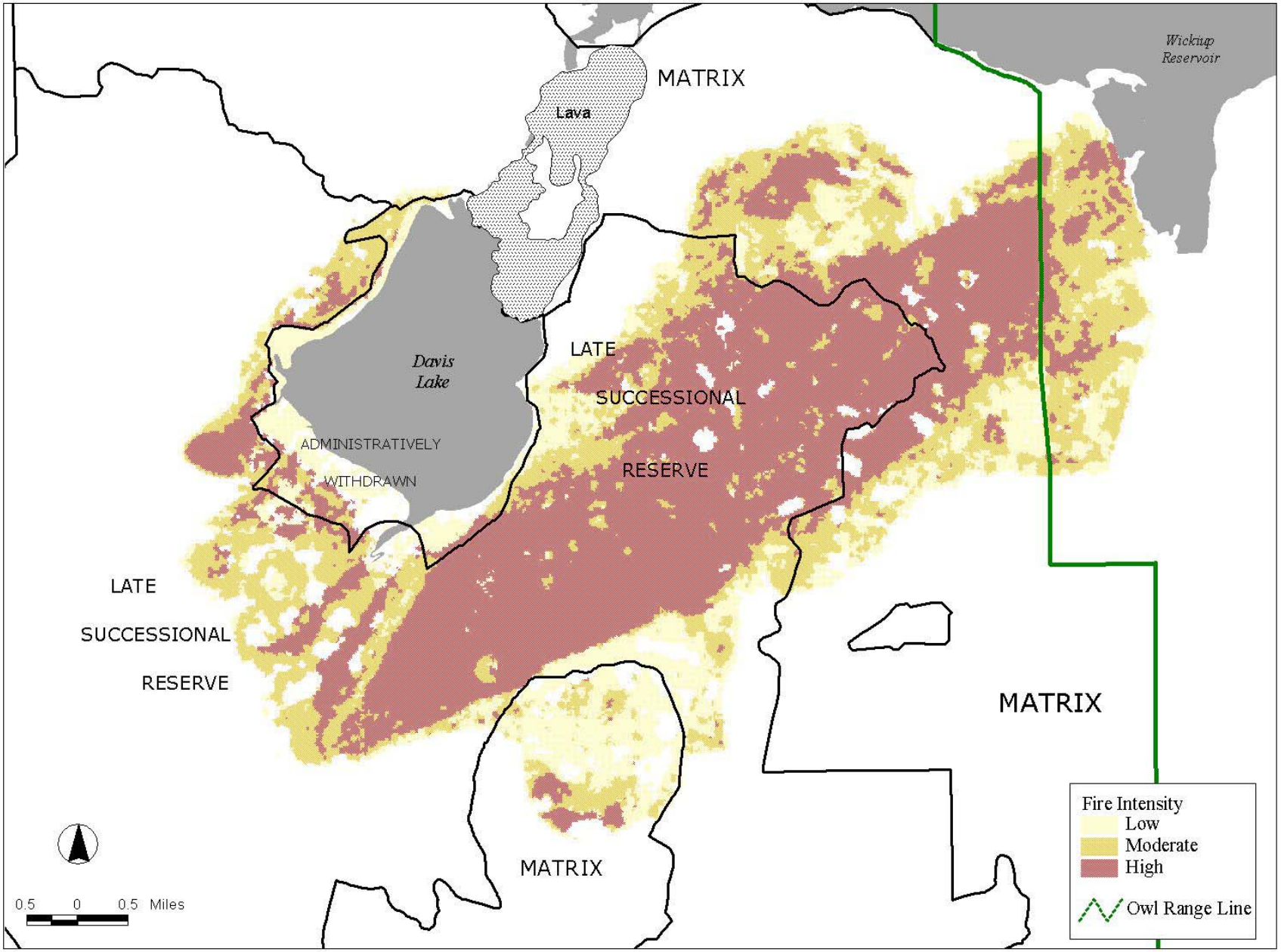
- Natural regeneration of the conifer species after a fire is dependent on seed dispersal from healthy trees. In many areas, particularly within the interior areas of the fire, adjacent seed sources will not be available for conifer species such as Douglas fir and ponderosa pine. These areas will require reforestation by planting. Replanting with the appropriate species will ensure timely establishment of species desirable for long-term objectives.
- Matrix lands are "where most timber harvest and silvicultural activities would be conducted" (ROD C-39), and the objectives of reforestation within the Matrix lands is to provide a source of habitat diversity, wildlife dispersal, and to provide connectivity between LSRs.
- The lodgepole flat area south of Davis Lake would see natural regeneration over time, but because the area is a Key Elk Area, the purpose of planting is to accelerate development of cover and forage in certain areas to meet Forest Plan standards and guidelines.
- Plant riparian shrubs to recover shade along Odell Creek more quickly and to establish riparian species before lodgepole pine becomes established.

There is a need to recover the timber volume in this instance where a catastrophic event clearly killed more trees than needed to maintain late successional conditions (NWFP ROD, p 66).

- Removing fire-killed trees through salvage logging will provide sawtimber and other wood products to the local and regional economies (NWFP ROD, A-1).
- Salvage of merchantable trees in all areas will help offset the costs of removing fuels in smaller unmerchantable size classes and reforestation through planting.

There is a need to improve public safety in the fire area.

- Reduce hazards associated with danger trees along major roads by removing them.



Map #2 Fire Intensity and Northwest Forest Plan Allocations

Planning Framework

Current Laws

Development of this Environmental Impact Statement follows implementing regulations of the National Forest Management Act (NFMA); Title 36, Code of Federal Regulations, Part 219 (36 CFR 219); Council of Environmental Quality, Title 40; CFR, Parts 1500-1508, National Environmental Policy Act (NEPA).

Many federal and state laws, including the Forest and Rangeland Renewable Resources Act (RPA), Endangered Species Act, Clean Air Act, and Clean Water Act also guide this analysis. The following is a brief explanation of each of these laws and their relation to the current project planning effort.

The American Antiquities Act of 1906

This Act makes it illegal to appropriate, excavate, injure, or destroy any historic, prehistoric ruin or monument, or any object of antiquity, situated on lands owned by the Government of the United States, without permission of the Secretary of the Department of the Government having jurisdiction over the lands on which said antiquities are situated.

The National Historic Preservation Act of 1966, as amended

This Act requires Federal agencies to consult with American Indian Tribes, State and local groups before nonrenewable cultural resources, such as archaeological and historic structures, are damaged or destroyed. Section 106 of this Act requires Federal agencies to review the effects project proposals may have on the cultural resources in the Analysis Area.

The Endangered Species Act of 1973, as amended

The purposes of this Act are to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such tests as may be appropriate to achieve the purpose of the treaties and conventions set forth in subsection (a) of this section." The Act also states "It is further declared to be the policy of Congress that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act."

The Migratory Bird Treaty Act of 1918

The purpose of this Act is to establish an international framework for the protection and conservation of migratory birds. The Act makes it illegal, unless permitted by regulations, to "pursue, hunt, take, capture, deliver for shipment, ship, cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, including in this Convention…for the protection of migratory birds…or any part, nest, or egg of any such bird" (16USC 703). The original 1918 statute implemented the 1916 Convention between the United States and Great Britain (for Canada). Later amendments implemented treaties between the Unites States and Mexico, Japan, and the Soviet Union (now Russia).

The National Environmental Policy Act (NEPA) of 1969, as amended

The purposes of this Act are "To declare a national policy which will encourage productive and enjoyable harmony between man and his environment, to promote efforts which will prevent or eliminate damaged to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nations; and to establish a Council on Environmental Quality" (42 U.S.C. Sec. 4321). The law further states "it is the continuing policy of the Federal Government, in cooperation, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of the present and future generations of Americans. This law essentially pertains to public participation, environmental analysis, and documentation.

The National Forest Management Act (NFMA) of 1976

This Act guides development and revision of National Forest Land Management Plans and has several sections to it ranging from required reporting that the Secretary must submit annually to Congress to preparation requirements for timber sale contracts. There are several important sections within the act, including Section 1 (purpose and principles), Section 19 (fish and wildlife resources), Section 23 (water and soil resources), and Section 27 (management requirements).

The Clean Water Act, as amended in 1977 and 1982

The primary objective of this Act is to restore and maintain the integrity of the Nation's waters. This objective translates into two fundamental national goals: 1. Eliminate the discharge of pollutants into the nation's waters; and 2. Achieve water quality levels that are fishable and swimmable. This Act establishes a non-degradation policy for all federally proposed projects. Under Section 303(d) of the Clean Water Act, the State has identified water quality-limited water bodies in Oregon. Odell Creek is the only water body in the project area that is on the 303(d) list.

The Clean Air Act, as amended in 1990

The purposes of this Act are "to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population; to initiate and accelerate a national research and development program to achieve the prevention and control of air pollution; to provide technical and financial assistance to state and local governments in connection with the development and execution of their air pollution prevention and control programs; and to encourage and assist the development and operation of regional air pollution prevention and control programs."

Multiple-Use Sustained-Yield Act of 1960

The Multiple Use – Sustained Yield Act of 1960 requires the Forest Service to manage National Forest System lands for multiple uses (including timber, recreation, fish and wildlife, range, and watershed). All renewable resources are to be managed in such a way that they are available for future generations. The harvesting and use of standing timber can be considered a short-term use of a renewable resource. As a renewable resource, trees can be re-established and grown in again if the productivity of the land is not impaired.

Migratory Bird E.O. 13186

On January 10, 2001, President Clinton signed an Executive Order (E.O. 13186) titled "Responsibilities of Federal Agencies to Protect Migratory Birds." This E.O. requires the *"environmental analysis of Federal actions, required by NEPA or other established environmental review processes, evaluates the effects of actions and agency plans on migratory birds, with emphasis on species of concern."*

Forest Order 12962 (aquatic systems and recreational fisheries)

This 1995 order's purpose is to conserve, restore, and enhance aquatic systems to provide for increased recreational fishing opportunities nationwide. It requires federal agencies to evaluate the effects of federally funded actions on aquatic systems and document those effects relative to the purpose of this order.

Executive Order 13112 (invasive species)

This 1999 order requires Federal agencies whose actions may affect the status of invasive species to identify those actions and within budgetary limits, "(i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species… (iii) monitor invasive species populations… (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded;…(vi) promote public education on invasive species… and (3) not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species… unless, pursuant to guidelines that it has prescribed, the agency had determined and made public… that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions."

Forest Plan Direction

Deschutes Forest Plan

Guidance for management activities is provided by the Deschutes National Forest Land and Resource Management Plan of 1990 (LRMP) as amended. The LRMP establishes goals, objectives, standards, and guidelines for each specific management area of the Forest, as well as Forest-wide standards and guidelines. Management Areas and associated standards and guidelines are described in Chapter 4 of the LRMP. Management Areas affected by the fire within the project area include the following (map #3, page 15):

M1: Special Interest Area (approximately 1,029 acres; 5% of the project area)

The goal of Special Interest Areas is to preserve and provide interpretation of unique geological, biological, and cultural areas for education, scientific, and public enjoyment purposes, where the primary benefiting uses will be for developed and dispersed recreation, research, and education opportunities (Deschutes LRMP, p 4-90).

M3: Bald Eagle (approximately 3,466 acres; 16% of the project area)

Habitat within BEMAs is to be managed to enhance the carrying capacity of bald eagles. Objectives include protecting and enhancing nesting habitat and foraging areas; providing suitable nesting sites on a continuing basis; and emphasizing old growth stands with large trees. Human disturbance will be minimal during nesting season (Deschutes LRMP, p 4-94).

M8: General Forest (approximately 7,541 acres; 36% of the project area)

Within the General Forest MA, timber production is to be emphasized while providing forage production, visual quality, wildlife habitat, and recreational opportunities for public use and enjoyment. The objective is to continue to convert unmanaged stands to managed stands with the aim of having stands in a variety of age classes with all stands utilizing the site growth potential (Deschutes LRMP, p 4-117).

M9: Scenic Views (approximately 8,423 acres; 40% of the project area)

The project area contains scenic views in the foreground and midground. The goal of scenic views management areas is to provide high quality scenery that represents the natural character of Central Oregon. Landscapes seen from selected travel routes and use areas are to be managed to maintain or enhance their appearance. To the casual observer, results of activities either will not evident, or will be visually subordinate to the natural landscape (Deschutes LRMP, p 4-121).

M11: Intensive Recreation (approximately 291 acres; 1% of the project area)

The goal of this MA is to provide a wide variety of quality outdoor recreation opportunities within a Forest environment where the localized settings may be modified to accommodate large numbers of visitors and where undeveloped recreation opportunities may occur (Deschutes LRMP, p 4-135).

M15: Old Growth (approximately 286 acres; 1% of the project area)

Old Growth Management areas are intended to provide naturally-evolved old growth forest ecosystems for (1) habitat for plant and animal species associated with old growth forest ecosystems, (2) representations of landscape ecology, (3) public enjoyment of large, old tree environments, and (4) the needs of the public from an aesthetic spiritual sense. They will also contribute to the biodiversity of the Forest (Deschutes LRMP, p 4-149). There are no proposed commercial activities within this Management Area.

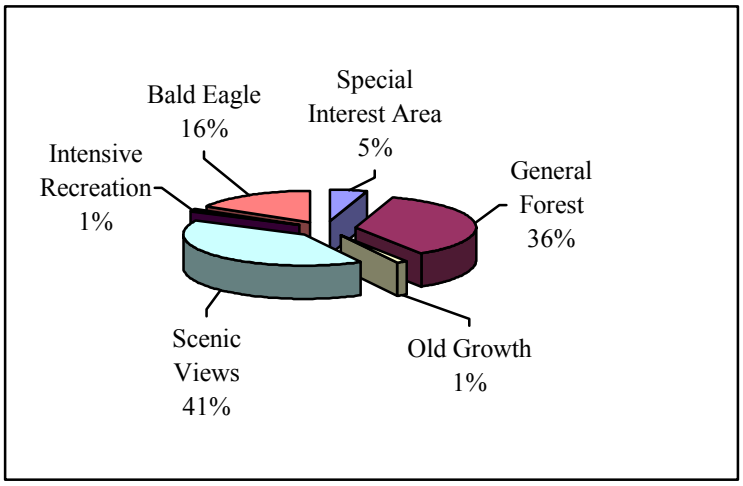
Davis Lake Key Elk Area (1,750 acres)

Elk are found in certain key habitat areas, within which management will provide conditions needed to support certain numbers of summering and wintering elk. The Davis Lake Key Elk Area (figure 3.10) is one of 11 on the Deschutes National Forest and overlaps the other management allocations. Standards and Guidelines address recreation, road, and vegetation management (Deschutes LRMP, p 4-55).

Management Indicator Species (MIS)

During the preparation of the Deschutes National Forest Land and Resource Management Plan (USDA 1990), a group of wildlife species were identified as management indicator species (MIS). These species were selected because their welfare could be used as an indicator of other species dependent upon similar habitat conditions. Indicator species can be used to assess the impacts of management actions on a wide range of other wildlife with similar habitat requirements. These species are not assigned Management Areas. Rather, Standards and Guidelines are applicable Forest-wide. The species selected for the Deschutes National Forest are listed in Chapter 3, under the MIS section.

Figure 1.4 Distribution of Davis Fire by Management Area



Northwest Forest Plan

In 1994, the Record of Decision for Amendments to the Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl (Northwest Forest Plan) amended the Deschutes Forest Plan. Much of the project area became Late Successional Reserve under the Northwest Forest Plan (map #4, page 16). The following Land Allocations occur within the project area:

Late Successional Reserve (approximately 11,820 acres, 56% of the project area)

The objective of Late Successional Reserves is to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth related species including the northern spotted owl (NWFP, p C-9). Standards and guidelines for LSRs include guidelines for salvage, which is defined as "removal of trees from an area following a stand replacement event" (NWFP, p C-13). The Davis Late Successional Reserve covers approximately 50,000 acres. An LSR Assessment was completed in 1995, and updated in 2003.

Matrix (approximately 6,425 acres; 31% of the project area)

This management allocation consists of federal lands outside the other categories of designated areas. Most timber harvest and other silvicultural activities would be conducted in the matrix where there is a suitable forest land, according to standards and guidelines. Most scheduled timber harvest takes place in the matrix (NWFP, p C-39).

Administratively Withdrawn (approximately 1,020 acres; 5% of the project area)

These are areas identified in current Forest and District Plans or draft plan preferred alternatives that are already being managed to provide benefit to late and old species. Management emphasis precludes scheduled timber harvest (NWFP, p C-29). In the Davis project area, the Administratively Withdrawn allocation corresponds to the Davis Lake Special Interest Area of the Deschutes LRMP.

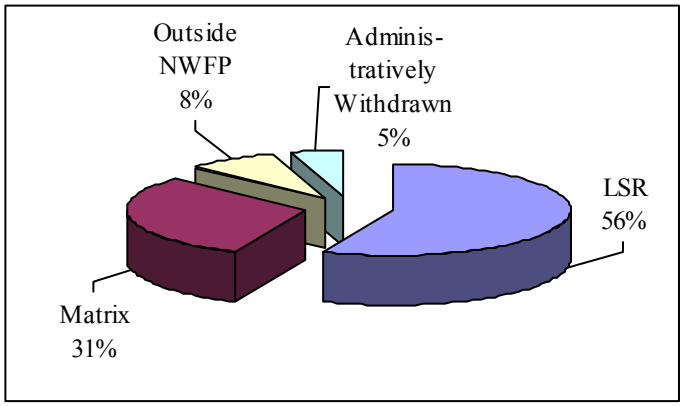
Riparian Reserve (approximately 800 acres; 4% of the project area)

Riparian Reserves overlap other management allocations and are one of the four components of the Northwest Forest Plan's Aquatic Conservation Strategy (NWFP, p B-12). They are portions of watersheds where riparian-dependent resources receive primary emphasis and where special standards and guidelines apply that prohibit and regulate activities that retard or prevent attainment of the Aquatic Conservation Strategy objectives.

Key Watershed (approximately 3,085 acres; 15% of the project area)

The Odell Creek 6th field watershed (1707030204) is a Tier 1 Key Watershed, which contributes directly to the conservation of the threatened bull trout and resident fish populations. As another component of the Aquatic Conservation Strategy, key watersheds provide high quality habitat for at-risk stocks of resident fish species. They are to serve as refugia for maintaining and recovering habitat for these at-risk species. The key watershed designation overlaps other management allocations. (NWFP, p B-18)

Figure 1.5 Distribution of Davis Fire area by Northwest Forest Plan Allocation



Approximately 1,735 acres of the project area (8%) are outside the area covered by the Northwest Forest Plan, and fall under the direction of the Inland Native Fish Strategy (INFISH; 1995) and the Eastside Screens (1995). INFISH provides interim direction to protect habitat and populations of resident native fish, and the Eastside Screens provide direction for retention and promotion of late/old structural forest characteristics.

Eastside Screens

The Revised Continuation of Interim Management Direction Establishing Riparian, Ecosystem, and Wildlife Standards for Timber Sales, or Eastside Screens, amended the Forest Plan in 1995. It applies to the design and preparation of timber sales on eastside Forests, is often referred to as "Regional Forester's Forest Plan Amendment #2" or as the "Eastside Screens."

RHCA Riparian Habitat Conservation Areas

RHCAs are portions of watersheds that have been delineated through the Inland Native Fish Strategy (INFISH) and overlap with some of the Forest Plan Management Areas listed above. Riparian-dependent resources receive primary emphasis in these areas. In the Davis Fire area, RHCAs occur along ephemeral draws (50 foot slope distance on both sides), and around the shore of Wickiup Reservoir. No salvage harvesting or fuels reductions are proposed in any RHCAs.

Local Assessments

Watershed Assessment

In 1999, the Crescent Ranger District completed the Odell Watershed Analysis which applies to more than half of the project area. The Big Marsh Watershed Analysis, completed in 1997, covers a very small portion of the project area (about 3%). Though the naming conventions of watersheds and subwatersheds used in those assessments vary from the current designations as used in the Davis Fire Recovery project analysis, the information they provide is relevant to many aspects of the planning for this project.

The assessments present pre-fire conditions, processes, and trends that occur within the watersheds. These documents provide important background information for designing project work that will continue to move watersheds toward the desired conditions.

Late Successional Reserve Assessment

The Davis LSR Assessment was prepared in 1995 to answer two key questions: How does the Davis LSR serve as habitat for late-successional and old-growth related species including the northern spotted owl, and where and when are forest management activities needed to protect and enhance the existing and potential habitat for late-successional and old growth related species within the Davis LSR? The LSR is divided into Management Strategy Areas (MSAs). For each MSA, existing condition, desired condition, objective, management options, and monitoring and evaluation elements were identified. An update to the LSRA was completed in 2003 to adjust the recommended amount of down woody debris in lodgepole stands and adjusting the Management Strategy Area boundaries near the wildland-urban interface around Crescent Lake Junction.

Burned Area Emergency Rehabilitation (BAER)

Immediately following the Davis Fire, a Burned Area Emergency Rehabilitation (BAER) team met to evaluate threats to resources, property, and human life. Values at risk included road erosion and sedimentation, spread of noxious weeds, and safety of forest users.

After conducting field surveys to identify impacts, the BAER team concluded that no emergency treatments were necessary (USFS 2003d). After identifying and evaluating the values at risk, the team compiled the following recommendations which were brought forward and incorporated into related discussions in this document:

- Treat noxious weeds by hand pulling and spot spraying and monitor established populations within perimeter.
- Patrol roads after storm events checking culverts or other drainage features for problems in areas of moderate burn severity.
- Establish photo points along Odell Creek to monitor vegetative recovery in riparian areas and necessity of planting.

Davis Fire Rapid Assessment

The information in the Watershed and Late Successional Reserve Assessments describes pre-fire conditions, though the functional relationships of most ecosystem elements remain relevant. Immediately following the Davis Fire, a rapid assessment was undertaken to assess the fire's effects on the landscape, provide a context for future actions to address the fire's effects, and facilitate program and budget development. General guidelines and recommendations were also provided. The assessment will be used to update information contained in previous assessments and provide information about the area that was burned in 2003. A complete set of flight photos was obtained in September of 2003 to complete site-specific inventory efforts.

Roads Analysis

According to the Forest Service Road Management Policy published January 12, 2001, all NEPA decisions signed after January 12, 2002, which involve certain changes in the transportation system, must be informed by a Roads Analysis. A project-level Roads Analysis was completed for the Davis Fire Recovery Project area. The Roads

Analysis was an interdisciplinary process that provides the decision maker information on the needs, opportunities, and priorities for the road system. The report concluded that a sufficient transportation system can be kept in place while at the same time road closures and decommissioning can move the fire area towards Forest Plan standards and guidelines for road density, address concerns about habitat effectiveness since the fire, and reduce impacts to streamside habitat. These recommendations will be carried forward in a subsequent analysis while the recommended roads for closure remain temporarily closed under the Davis Fire Closure Order. The analysis was consistent with the Forest-wide Roads Analysis Report that analyzed the transportation system on the Deschutes and Ochoco National Forests focusing on major roads.

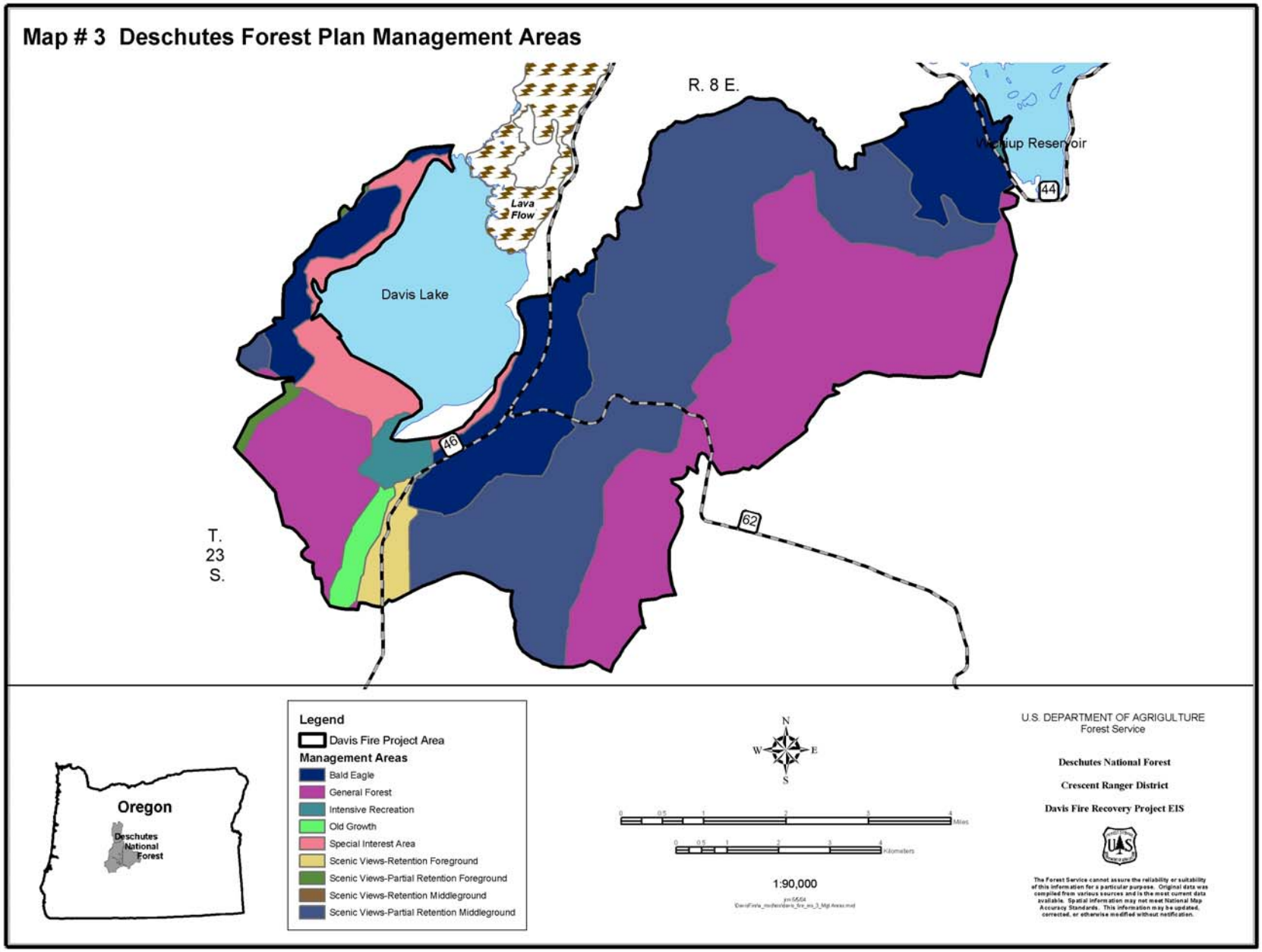
Crescent District Landscape Assessment (LAP)

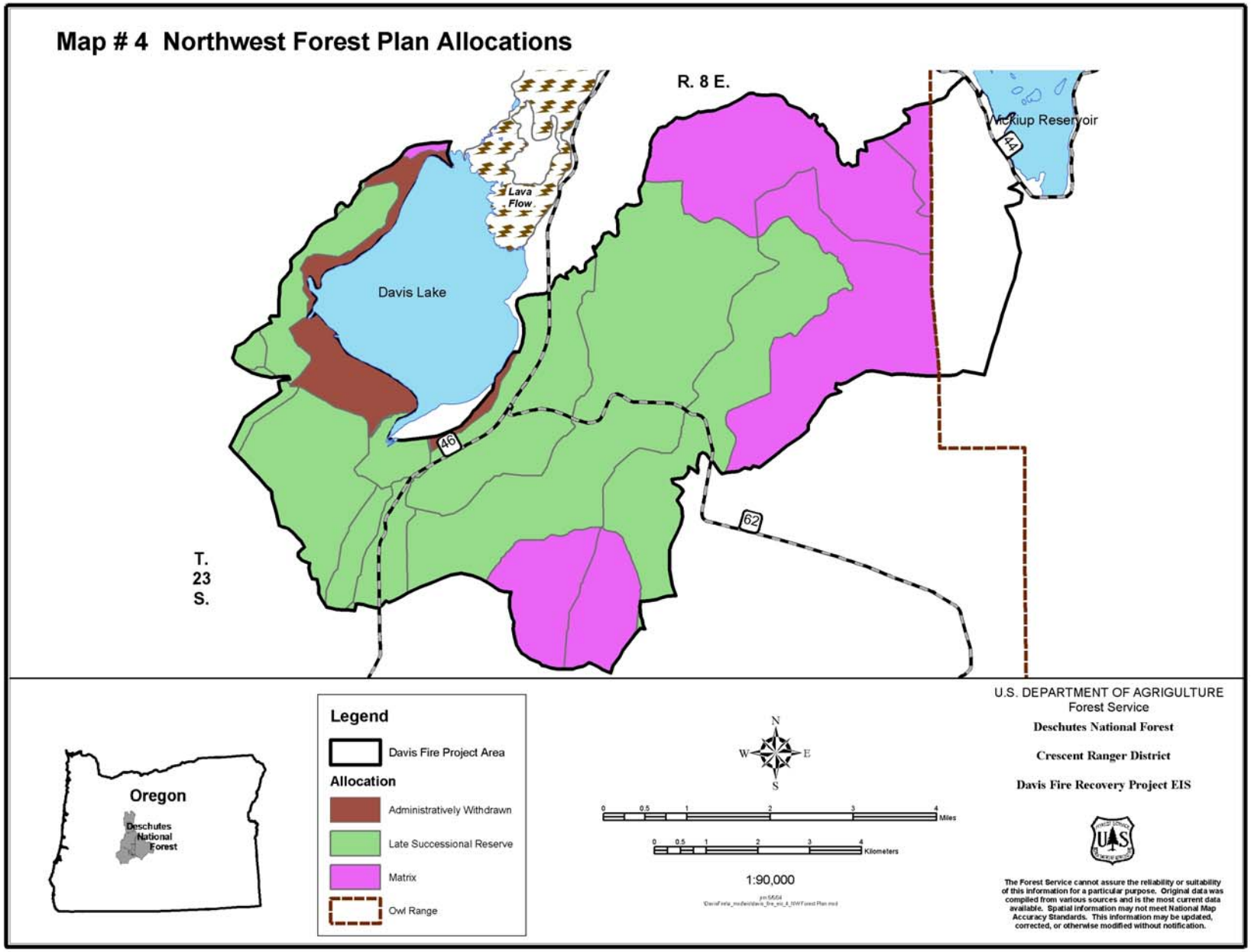
A district-wide landscape assessment was undertaken in 1998 to clarify important environmental conditions and trends. The assessment resulted in tables displaying the historic range of variability, current condition, and desired future condition for each plant association group by subwatershed. Disturbance regimes, vegetation development, and wildlife management indicator species are identified for each PAG as well. This information was then used to identify key trends and priority areas such as those imminently susceptible to catastrophic losses from insect, disease, or wildfire. In terms of wildlife, LAP tabulated the amount of existing home range equivalents and habitat for each of seven Management Indicator Species (MIS) across the District and compared it to the desired future condition. Much of the mixed conifer PAG, which is prevalent in the Davis Fire area, was shown to be imminently susceptible.

Project Record

This EIS hereby incorporates by reference the Project Record (40 CFR 1502.21). However, for some resources, Chapter 3 provides a summary of the Specialist Reports in adequate detail to support the rationale for the decisions; appendices provide supporting documentation. The Project Record contains Specialist Reports and other technical documentation used to support the analysis and conclusions in this EIS.

Incorporating these Specialist Reports and the Project Record help implement the Council on Environmental Quality (CEQ) Regulations provision that agencies should reduce NEPA paperwork (40 CFR 1500.4), that EISs shall be “analytic rather than encyclopedic,” and that EISs “shall be kept concise and no longer than absolutely necessary” (40 CFR 1502.0). The objective is to furnish enough site-specific information to demonstrate a reasoned consideration of the environmental impacts of the alternative and how these impacts can be mitigated, without repeating detailed analysis and background information available elsewhere. The project Record is available for review at the Crescent Ranger District Office, 136471 Hwy 97 N., Crescent, Oregon, Monday through Friday 7:45 a.m. to 4:30 p.m.


Map # 3 Deschutes Forest Plan Management Areas
R. 8 E.
T. 23 S.
Davis Lake
Lava Flow
Wickiup Reservoir
46
44
62
Oregon
Deschutes National Forest
Legend
Davis Fire Project Area
Management Areas
Bald Eagle
General Forest
Intensive Recreation
Old Growth
Special Interest Area
Scenic Views-Retention Foreground
Scenic Views-Partial Retention Foreground
Scenic Views-Retention Middleground
Scenic Views-Partial Retention Middleground
N
W
E
S
Miles
Kilometers
1:90,000
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS
The Forest Service cannot assure the reliability or suitability of this information for a particular purpose. Original data was compiled from various sources and is the most current data available. Spatial information may not meet National Map Accuracy Standards. This information may be updated, corrected, or otherwise modified without notification.


Map # 4 Northwest Forest Plan Allocations
R. 8 E.
T. 23 S.
Davis Lake
Lava Flow
Wickiup Reservoir
46
62
44
Oregon
Deschutes National Forest
Legend
Davis Fire Project Area
Allocation
Administratively Withdrawn
Late Successional Reserve
Matrix
Owl Range
N
W
E
S
Miles
Kilometers
1:90,000
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS
The Forest Service cannot assure the reliability or suitability of this information for a particular purpose. Original data was compiled from various sources and is the most current data available. Spatial information may not meet National Map Accuracy Standards. This information may be updated, corrected, or otherwise modified without notification.

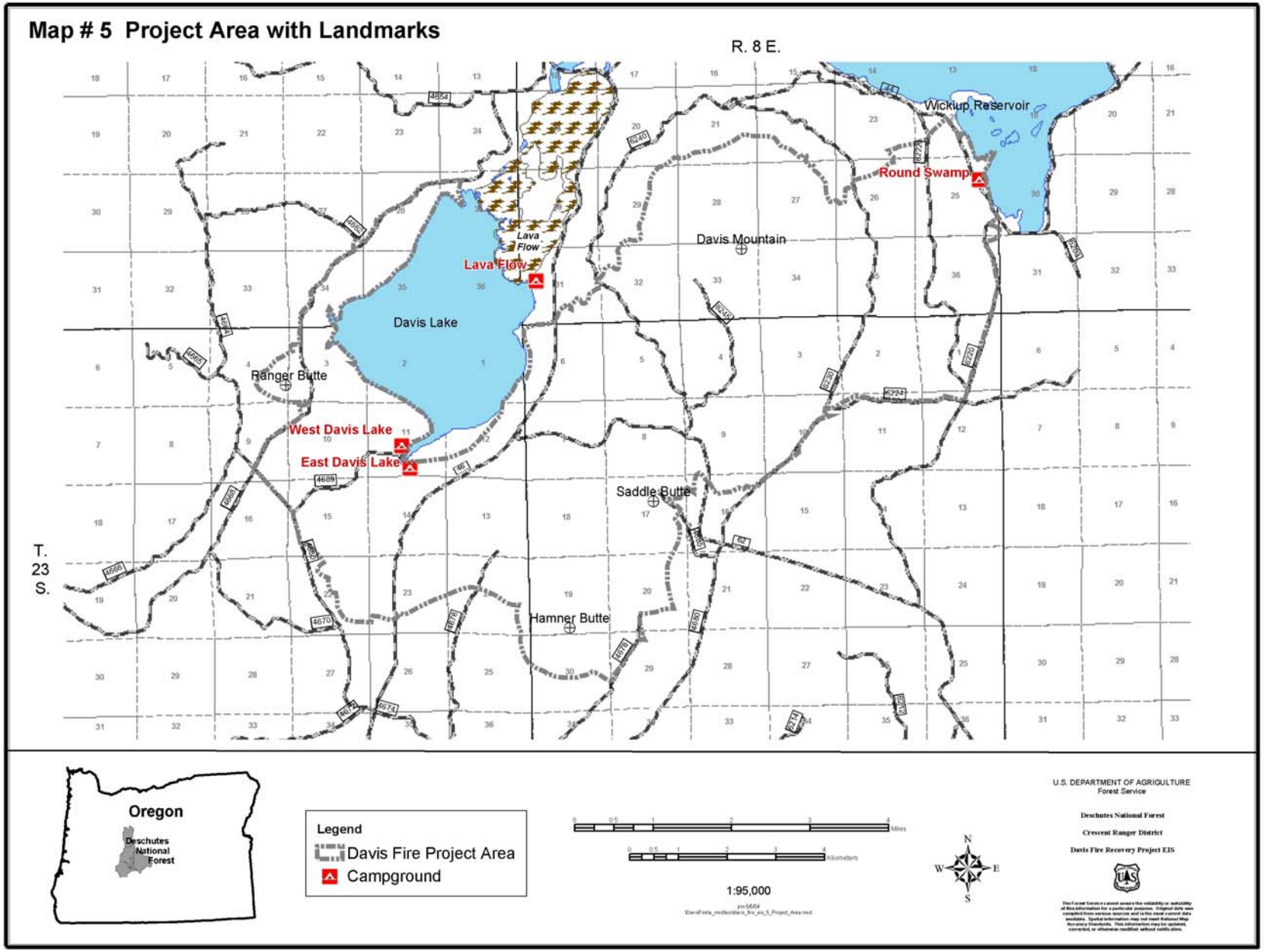
Scope of Project and Decision Framework

The scope of the project and the decision to make are limited to: commercial salvage; fuels reduction; reforestation; hazard reduction; a site-specific Forest Plan amendment; and mitigation and monitoring within areas burned by the fire of 2003. Chapter 2 details the designs of these actions. The project is limited to National Forest System lands within the project area. Connected actions to be included in the decision include: temporary road development.

The Responsible Official for this proposal is the Forest Supervisor of the Deschutes National Forest. After completion of the Draft EIS, there was a 45-day public comment period. Based on response to the Draft EIS and the analysis disclosed in this Final EIS, the Responsible Official will make a decision and document it in a Record of Decision (ROD). The Responsible Official can decide to:

- Select the proposed action, or
- Select an action alternative that has been considered in detail, or
- Modify an action alternative, or
- Select the no-action alternative
- Identify what mitigation measures will apply.

The decision regarding which combination of actions to implement will be determined by comparing how each factor of the project purpose and need is met by each of the alternatives and the manner in which each alternative responds to the key issues raised and public comments received during the analysis. The alternative which provides the best mix of prospective results in regard to the purpose and need, the issues and public comments, will be selected for implementation.


Map # 5 Project Area with Landmarks
R. 8 E.
T. 23 S.
Wickiup Reservoir
Round Swamp
Davis Mountain
Lava Flow
Lava Flow
Davis Lake
Ranger Butte
West Davis Lake
East Davis Lake
Saddle Butte
Hamner Butte
Oregon
Deschutes National Forest
Legend
Davis Fire Project Area
Campground
Miles
Kilometers
1:95,000
N
S
E
W
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS

Chapter 2

Alternatives Including the Proposed Action

CHAPTER 2 – ALTERNATIVES INCLUDING THE PROPOSED ACTION

Introduction

This chapter describes the public involvement process and identifies key issues around which alternatives were developed. It also describes and compares the five alternatives considered for the Davis Fire Recovery Project, including a description and map of each alternative considered. The interdisciplinary team developed four action alternatives. Alternative B is the Forest Service's Preferred Alternative.

This section presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options to the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative (i.e., helicopter logging versus the use of skid trails) and some of the information is based upon the environmental, social and economic effects of implementing each alternative (i.e., the amount of erosion caused by helicopter logging versus skidding).

Chapter 2 Changes Between Draft EIS and Final EIS

Within Chapter 2, the following changes were made:

- A section on Sale Area Improvement Projects has been added
- Clarification and wording changes in the mitigation, northern bald eagle and northern spotted owl sections were a result of ongoing consultation with the US Fish and Wildlife Service and new information resulting from 2004 field surveys.

Scoping and Public Involvement

The complete record of the public involvement process to date is available for review in the project file. The Davis Fire Recovery Project was initially presented to the public in a letter dated September 8, 2003 that was sent to the Crescent Ranger District's NEPA mailing list of 88 individuals, groups, and agencies (table 2.1). The letter described the purpose and need and the proposed action. The proposed action was posted on the Deschutes National Forest's web site on September 10, 2003. An article describing the proposal appeared in *The Bend Bulletin* on September 12, 2003. The project was listed in the *Schedule of Projects for the Deschutes and Ochoco National Forests and the Prineville District of the BLM* beginning with the Fall 2003 issue. A Notice of Intent to Prepare an Environmental Impact Statement was published in the Federal Register on September 17, 2003 (Vol. 68, No. 180).

Table 2.1 Crescent Ranger District's NEPA Mailing List, September 8, 2003

American Forest Resources Council, Chuck Burley
Associated Oregon Loggers, Inc., Jim Geisinger
Bend/Ft. Rock Ranger District, Mark Macfarlane
Blue Mountains Biodiversity, Karen Coulter
Bohemia Sno-Sledders, Hal Heideman
Boise Cascade Corporation
Bonneville Power Administration, Libby Johnson
Bureau of Land Management, Elaine Marquis-Brong
Burns Paiute Tribe, Beth Coahran
C & B Construction, Carrie Kugler
Cascadia Wildlands Project, Josh Laughlin
Central Oregon Fly Fishers, Ned Austin
Central Oregon Fly Fishers, Robert Speik
Central Point Lumber, Warren Hudspeth
Columbia Helicopters, David Horrax
Confederated Tribes of the Warm Springs Reservation, Robert Brunoe
Confederated Tribes of the Warm Springs Reservation, Fara Ann Currim
Consolidated Pine, Elden Ward
Deschutes National Forest, Susan Skakel
DR Johnson Lumber Co., Gerald Keck
Environmental Protection, Judith Leckrone Lee
Forest Action - Survival Center
Forest Conservation Council, John Talberth
Forestry Action Committee, Susan Chapp
Frontier Advertiser
Herald & News
Jefferson Center, Beverly Brown
Klamath Forest Alliance, Kyle Haines
KLE Enterprises, Inc., Ken Evans
KTVZ
Native Plant Society, Stu Garrett, M.D.
Northwest Environmental Defense, Erin Uhlemann
Northwest Special Forest Products
NRDC, Travis Faircloth
Ochoco Lumber Company, Bruce Daucsavage
Ochoco Lumber Company, John Morgan
Oregon Dept. of Fish and Wildlife, Chip Dale
Oregon Dept. of Fish and Wildlife, Steve George
Oregon Dept. of Fish and Wildlife, Corey Heath
Oregon Dept. of Fish and Wildlife, Clair Kunkel
Oregon Dept. of Fish and Wildlife, Steve Marx
Oregon Dept. of Transportation, Gary Larson
Oregon Eagle Foundation
Oregon Hunters, Kelly Smith
Oregon Natural Resources, Doug Heiken
Oregon Natural Resources, Tim Lillebo
Oregon State Snowmobile Assn., Howard Gieger
Pacific West Community Forestry, Katie Bagby
PROWL, Lisa Blanton
Quincy Library Group, Linda Blum
Shelter Cove Resort, Jim & Trula Kielblock
Sisters Ranger District, Tom Mafera
Sunriver Owners Association, Bill Chapman
Superior Helicopter, Carson Johnson
The Bulletin, Rachel Odell
The Klamath Tribes, Allen Foreman
The Klamath Tribes, Willie Hatcher
The Nugget Newspaper, Eric Dolson
The Wilderness Society, Robert Freimark
Tribal Council of the Burns Paiute
Trout Unlimited, Tom Wolf
Union Pacific Railroad, Kevin Adams
Upper Deschutes Watershed, Ryan Houston
US Fish & Wildlife Service, Nancy Gilbert
US Fish & Wildlife Service, Jennifer O'Reilly
US Timberlands Services, Martin Lugus
USDA Forest Service SPS, ATTN: Appeals
Walker Rim Riders
Alliance of Forest Workers and Harvesters, Bradley Porterfield
Tom Coiner
Dick & Joani Dufourd
Harry Farley
Brian Fuller
Kyle Gorman
George & Virginia Heldt
Danny Hughes
Gene Keane
Rebecca McLain
Joni Mogstad
Bob Mullong
Vern Oden
Amphone Phonngam
Kao Saechao
Yan Saeteurn
Deng Sandara
Sothon S. Suy
Phet Thavisack
Roy Vermillion
Khamtan Vorasane

Written comments, letters, electronic mail responses or phone calls were received from 12 individuals, agencies, businesses, and organizations in response to this scoping effort. All comments were read by the ID Team and other staff to ensure consideration of all comments during the analysis process. Comments are located in the Project File at the Crescent Ranger District office.

A public field trip to the project area was provided on October 18th. The trip was announced in a news release that went to media outlets and was posted on the internet. Sixteen people participated in the public field trip:

Doug Brazil
Ronald E. Huff
Georgia Bonner
Ken Gibson
Pat Stone
Al Beesley
Marva Beesley
Susan Gray (Archaeological Society of Central Oregon)
Tom Coiner
Ted Scholer
James Larsen
Jerri Oppenheim
Bruce Nannen
Lacey Phillabaum (Cascadia Wildlands Project)
Lisa Blanton (PROWL Project)

Written comments received from the public tour participants are located in the project file.

Additional scoping and public involvement occurred with interested parties as follows:

- July 17, 2003 tour of project area with Deschutes Provincial Advisory Committee
- September 12, 2003 Bend Bulletin article announces Davis Fire Recovery Project proposed action and request for input
- October 10, 2003 tour of project area with Frank Isaacs (Oregon Eagle Foundation)
- October 18, 2003 bus tour of project area with interested public
- October 20, 2003 tour of project area with Society of American Foresters "Post-fire Restoration and Salvage Harvesting" conference (85 attendees)
- November 4, 2003 tour of project area with Tim Lillebo (Oregon Natural Resources Council)
- November 6, 2003 tour of project area with timber industry officials (Nine attendees)
- November 12, 2003 tour of project area with Karen Coulter (Blue Mountains Biodiversity Project)
- November 13, 2003 meeting with George Wilson (Sierra Club, Juniper Group)
- November 18, 2003 tour of project area with George Wilson (Sierra Club, Juniper Group)
- November 26, 2003 Letter to District mailing list (table 2.1) describing project alternatives to date
- December 12, 2003 presentation of Alternatives to the Provincial Advisory Committee (Deschutes PAC)

In addition, in April 2004 a Memorandum of Understanding between the Burns Paiute Tribe and the Deschutes, Ochoco, and Malheur National Forests was signed. This MOU will guide the government to government relationship between the groups.

Identification of Issues

Issues are points of discussion, debate, or dispute about environmental effects that may occur as a result of the proposed action. Issues provide focus and influence alternative development, including development of mitigation measures to address potential environmental effects, particularly potential negative effects. Issues are also used to display differing effects between the proposed action and the alternatives regarding a specific resource element.

The ID Team sorted the comments received during initial scoping into categories to help issue tracking and response. The issues are categorized as follows:

- **Key issues:** Issues used to develop the alternative and design elements. These are issues that cannot be resolved without some consideration of the trade-offs involved. Trade-offs can be more clearly understood by developing alternatives and displaying the relative impacts of these alternatives.
- **Analysis issues:** In addition to the key issues, other environmental components will be considered in the analysis in Chapter 3, though they did not result in differing design elements between alternatives. These

issues are important for providing the Responsible Official with complete information about the effects of the project.

Key Issues

The alternatives respond to the following key issues identified during initial project scoping, both public and internal. The key issues are specific to the proposed actions and the project area. Attributes and measures for each issue will help to evaluate how each of the alternatives addresses issues. Evaluations of each attribute and measure are provided later in this Chapter in the Comparison of Alternatives section.

Key Issue #1: Effects on Soils

Issue Statement: Cumulative impacts from proposed ground-based harvest and fuels treatment activities may lower soil productivity below desired levels.

Maintenance of soil productivity is an important objective for forest management. The loss of organic surface cover following the wildfire and suppression activities may have elevated the sensitivity of the soil resource to additional physical impacts such as displacement. In addition, past management activities have incurred various levels of impacts, such as displacement, that could cause proposed activities to cumulatively create detrimental disturbance in some areas at levels capable of affecting soil productivity.

Attributes and Measures:

- Area of detrimental disturbance
- Cumulative Effects of alternatives, past actions, and reasonably foreseeable future actions on productivity of soils in project area including amount of temporary road construction and harvest type.

Key Issue #2: Effects to Wildlife Habitat

Issue Statement: Salvage operations could negatively impact habitat for species dependent upon snags and down wood by removing snags. The Davis Fire created conditions that will provide a short-term benefit for cavity nesters and species that forage on the insect populations that result from high tree mortality events (approximately 3 – 15 years). Removal of merchantable material has the potential to limit the natural cycles of post-fire insect populations and the population dynamics of dependent foraging species.

Attributes and Measures:

- Snag levels

Key Issue #3: Passive Recovery in Late Successional Reserve vs. Recovery using Active Management, Including Commercial Salvage

Issue Statement: Active management in the post-fire landscape is opposed by some people. Some public comments show a desire for “natural” post-fire recovery and passive processes, and alternatives were suggested to restore the area through non-commercial means. Public input on the best approach to recovery demonstrates the divergent points of view on what approach to recovery would best accomplish the purpose and need. The essential indicator for this issue is the recovery of late and old structured stands over time.

Attributes and Measures:

- Expected influence of future fire effects in the project area: fire behavior, size, intensity and return interval
- Regeneration by species and method
- Forest succession and development of LOS: stand characteristics over time

Analysis Issues

Other issues and concerns were raised during scoping, both internally and externally, that did not result in different alternatives or design elements, but are considered during the analysis process and discussed in Chapter 3. These issues are generally less focused on the elements of Purpose and Need, than are the Key Issues.

Wildlife – In addition to the wildlife key issue, the following items will be analyzed and compared by alternative:

- Threatened, Endangered, Candidate and Sensitive Species
- Survey and Manage Species
- Management Indicator Species
- Resident and Migratory Landbirds

Water Quality and Fish Habitat - Odell Creek is listed on the 2002 303(d) list as "Water Quality Limited" by the Oregon Department of Environmental Quality for temperatures exceeding State guidelines. Bull trout, a federally Threatened species, and redband trout, a Regional Sensitive species, use Odell Creek. Harvest or road-building activities near streams or within riparian areas have the potential to impact water quality and fish habitat. In the design of the proposed action for the Davis Fire Recovery Project, no salvage or road building were proposed within 300 feet of Odell Creek, the other two perennial streams in the project area, or Davis Lake; therefore it is not considered a key issue.

Botany and Noxious Weeds – Proposed management activities have the potential to introduce or spread existing populations of noxious weeds and invader species. Potential spread of noxious weeds is a concern across the fire area.

Insects – Salvage operations are not proposed in the low-intensity fire area. This has the potential to exacerbate the spread of insects beyond the fire area. Certain insect populations typically increase following a wildfire. Infestations have the potential to become quite large and move beyond the perimeter of the fire, causing a risk to the quality of the adjacent owl and eagle habitat.

Cultural Resources – Proposed activities may have an effect on cultural resources. The Davis Lake area is rich in cultural resources. Proposed ground-disturbing activities such as harvest, fuels treatments, and planting of vegetation has the potential to disturb sites and compromise the recovery of information.

Recreation – Two developed recreation sites (East and West Davis Lake Campgrounds) are within the planning area. The Metolius-Windigo National Recreation Trail and dispersed camping sites are also located in the project area. Proposed salvage activities including danger tree removal may provide for public safety but may also affect recreational use of these sites.

Unroaded Areas – The EIS analyzes the amount of activities by alternative that would occur within unroaded areas within or overlapping the Project Area. Unroaded areas, as identified by the Roadless FEIS are separate from Inventoried Roadless Areas (IRAs). There are no Inventoried Roadless Areas within the project.

Scenery – Views from Highway 46 (the Cascade Lakes National Scenic Byway) and other visually sensitive areas, such as recreation sites, have been dramatically changed by the fire. Some respondents feel the public should be afforded the opportunity to view natural recovery without active management.

Economic and Social Analysis – Consideration must be given to the financial efficiency of the proposed action and alternatives. Some commenters want the Forest Service to salvage fire-killed trees in a timely manner to avoid drastic loss in value. Concerns over the economics of helicopter logging were also raised. Economic and social analysis focuses on the communities of Central Oregon and their ties to forest management through employment, income, recreation, fuelwood, and sport.

Range and Permits – There are no active range allotments or permits within or adjacent to the fire area.

Alternative Descriptions

Alternatives were developed by the Interdisciplinary Team to address the key issues. Five alternatives are analyzed in detail. All action alternatives meet the purpose and need for action in varying degrees.

Precision of Information and Adjustments

Quantifiable measurements, such as acres and miles, and mapped unit boundaries used to describe the alternatives and effects are based on the best available information. The analysis presented in this DEIS is based on consideration of the full extent of the acres, miles, and other quantities depicted in the alternatives. Information used in designing the alternatives was generated from a mix of field reconnaissance, use of post-fire aerial photos, use of global positioning system (GPS) technology, and various resource-specific databases. Ongoing field verification, including additional use of GPS, is expected to result in adjustments in acreages or other measurements.

Alternative A – (No Action)

Alternative A is the No Action alternative. This alternative is required by law and serves as a baseline for comparison of the effects of all of the alternatives. Under Alternative A, there would be no change in current management direction or in the level of ongoing management activities, such as road maintenance or the noxious weed treatment program, within the project area.

Any restoration would rely on a completely passive approach. There would be no salvage of fire-killed trees to reduce fuels; there would be no planting for reforestation of mixed conifer species; no small-diameter fuels reduction would take place; and no temporary roads would be constructed; no riparian shrubs would be planted in the riparian corridor of Odell Creek and there would be no planting to provide cover or forage within the Key Elk Area. Other than those deemed unsafe, all snags would be retained. No actions would be taken that would change current wildlife habitat or soil quality.

Actions and Design Elements Common to all Fully-Analyzed Action Alternatives

Introduction

This section will be used to describe each of the actions, or design elements of those actions, that are proposed in varying degrees in all fully developed action alternatives. Following a description of the actions, a table displays the connection that each action has to the project purpose and need. This relationship will be further discussed under each resource in the “Environmental Consequences” section of Chapter 3.

Description of Actions

Commercial Salvage

All fully developed action alternatives include some commercial salvage. Specific acreage is included in the individual alternative descriptions, along with the alternative-specific information on logging systems. Salvage harvest is limited to trees that have no green needles. Trees with green needles will be retained except under the small-diameter fuels treatments. Salvage logging will be done with either yarding with top attached to top log or whole tree yarding. Unmerchantable dead trees from 3 to 12 inches will be felled and piled over approximately 40 to 60 percent of each unit.

The Pacific Northwest Region directs Forests to use a standard for assessing survival of fire damaged trees. For the purposes of this proposed action, no live trees would be removed, except within small-diameter fuels treatment units that are strategically placed adjacent to commercial salvage units (see below). Commercial trees proposed for removal have 100% crown scorch and no live needles are visible.

Retention Areas

West of the Owl Range line, a minimum of 15 percent of the planned acreage for each unit will be left untreated to provide diversity across the landscape and maintain undisturbed habitat. Slopes greater than 25% will be targeted for retention areas in Alternatives B, C, and D; slopes greater than 25% will be avoided under Alternative E. The amount and distribution of snags to be left across the planning area is described in table 3.40 and Appendix D.

Salvage harvest will not occur in Riparian Reserves under any alternative and they will be included in the retention areas where they overlap units. The no-cut buffers around waterbodies are intended to prevent disturbance of soil, organic matter, and surface vegetation in order to maintain and enhance their function as sediment catches and refugia for wildlife.

Reforestation (Conifer Planting)

Following salvage and fuels treatments, reforestation will be initiated through planting of two year-old nursery stock. Within the action alternatives, planting of tree seedlings would occur in all of the salvage harvest units. The areas planted with conifers outside of salvage units vary between the alternatives. The species planted will depend on the plant association group and elevation. See page 3-152 for a more detailed discussion on reforestation.

Reforestation in Key Elk Area

In the Key Elk Management area, located in the lodgepole flats south of Davis Lake, natural regeneration will be monitored for two years in areas designated for big game cover. If adequate natural regeneration is not apparent after that time, planting of lodgepole pine will occur. In some areas around those designated for cover, bitterbrush will be planted for forage if after the two years of monitoring it is not regenerating. Reforestation in the key elk area is needed to meet Forest Plan standards and guidelines; therefore, natural regeneration will only be monitored for two years before planting begins.

Riparian Planting

Approximately 170 acres of the riparian area along Odell Creek will be planted with deciduous tree species and riparian shrubs including alder and willow.

Small-diameter Fuels Treatments

In addition to reducing future surface fuel loading by commercial salvage, small-diameter fuel reduction will take place within 600 feet of Highway 46, around East and West Davis Lake Campgrounds, and other strategic locations. These treatments will include thinning the small diameter materials (12” diameter or less; 8” diameter or less in spotted owl nesting, roosting, and foraging habitat), and then either piling and burning the slash or chipping it. Leave areas will be incorporated. Small-diameter fuels reduction within salvage units will occur across approximately 60 percent of the units.

Danger Tree Removal along Major Roads

In each of the action alternatives, danger trees will be removed along the 6230, 6240, and 6245 roads. A danger tree removal operation took place in the fall of 2003 on the other main roads that remained open to the public (62, 46, 44, 4660, 4669, 4600850, and 6220). The current project proposes removal of danger trees on the remaining collector roads in the fire area where salvage units do not border or straddle one of these roads. This will involve trees 6 inches in diameter or greater that are sufficiently tall to reach the roadbed and are leaning toward the road. Most danger trees are within 100 feet of either side of a road.

Temporary Road Development

Salvage harvest operations are expected to require the use of temporary roads. The amount of temporary roads varies by alternative and is displayed with the alternative descriptions. Actual temporary road locations are determined through agreement by the Forest Service during timber sale contract administration. Temporary roads would be constructed to provide access to the interior of harvest units to facilitate ground-based harvest systems. These roads would be built on relatively flat ground slopes (less than 15%) and would be constructed to the lowest possible standard capable of supporting log haul in order to minimize ground disturbance. In many instances, as is typical in the case of ground-based systems, individual temporary roads would be constructed along the route of previously established skid trails to minimize construction costs associated with clearing the road template. This would result in little extra disturbance within the unit beyond what would already be experienced as a result of the employment of ground-based yarding systems.

Forest Plan Amendment

Visual Quality

A short-term, non-significant, site specific amendment of the visual quality standards and guidelines in the Deschutes National Forest Land and Resource Management Plan is incorporated into the design of Alternatives B, C, and E. It allows tree removal and slash to be visible to the "casual observer" for longer periods than under the existing Standards and Guidelines on approximately 100 acres. Though the current Visual Quality Standards and Guidelines would not be met in the short-term, the proposed activities are expected to better meet visual quality objectives for the long-term (over five to ten years). Following is a description of proposed changes to the existing standards and guidelines for Scenic Views (MA9).

A goal for scenic views in the project area is to provide forest visitors with high quality scenery that represents the natural character of Central Oregon. The objectives call for enhancing landscapes by opening views to distant peaks, and highlighting large ponderosa pine. The Scenic Views allocation of "retention-foreground" applies to the area ¼ mile on either side of Forest Road 46 for a distance of 4.6 miles within the Davis Fire perimeter. Within this zone there are two distinct plant association groups: ponderosa pine and mixed conifer.

The Forest Plan is vague regarding active management, or salvage, within landscapes that have had a wildfire and are allocated to the Scenic Views Management Area. The Forest Service Manual (FSM 2380) for Landscape Management classifies the landscape where the wildfire occurred as "distinctive." This effectively sets the post-fire landscape as the starting point for assessing scenic views; not the pre-fire forested condition. Although proposed activities are intended to meet this goal and the Standards and Guidelines over the long-term (longer than 5 years), short-term visual impacts are expected that are not considered subordinate to the landscape for ponderosa pine in a wildfire scenario. These are:

1. Removal of dead trees in contrast to the surrounding wildfire landscape for Retention Foreground allocation. Textural changes will be visible until remaining standing trees begin to fall.
2. Visible stumps along Cascade Lakes Highway.
3. Potential for contrasting soil.
4. Timing of slash cleanup. The labor-intensive nature of handpiling and removal of activity-generated tops and limbs may not be completed within one year.

As such, it is recommended that the following Standards and Guidelines be amended:

M9-4, Ponderosa Pine Foreground– Desired Visual Condition

Alternatives B, C, and E proposed actions of salvage and timing of slash cleanup are expected to result in visible changes noticeable by the casual observer in this management area over approximately 100 acres. It is proposed that these Standards and Guidelines be amended to accept that the casual forest visitor may notice short-term changes in this allocation. These objectives would be met over the long term (5 years and longer) through regeneration of ponderosa pine, herbaceous recovery, and natural fall of remaining standing dead trees.

M9-8, Timing of Cleanup Activities in Ponderosa Pine Foregrounds, Mixed Conifer Foregrounds

These Standards and Guidelines establish that slash, logging residue, or other results of management activities will not be obvious to the casual forest visitor one year following the activity in Retention areas. Although the Crescent Ranger District intends to clean up the slash as soon as possible, this project would employ handpiling and disposal which is labor intensive. The Forest Service recommends that these Standards and Guidelines be amended to allow visible effects of harvest cleanup for approximately 2 years.

Alternative B (Preferred)

Alternative B is the proposed action. The proposed action was based on preliminary information developed during July and August of 2003. It was developed using satellite data to identify the areas of the high and moderate intensity burn combined with pre-fire photo-interpreted vegetation data to identify stands within certain size classes and stand densities. These areas were the initial proposal for salvage harvesting. Minor adjustments have been made to the original proposal primarily based on additional site-specific information derived from field reconnaissance and aerial photo delineations.

Alternative B maximizes ground-based logging methods (3,785 acres) to be able to better reduce fuels profiles in the most economical manner. Aerial harvest systems are proposed on steeper slopes, where access is marginal on Davis Mountain and Saddle Butte, and around Davis Lake. At roughly 1/3 of the fire area included in the proposed action, this is the broadest application of fuel treatment activities possible while considering other resource values.

Areas to reforest were identified as the salvage units, plantations that were in the high/moderate burn, portions of the lodgepole flat area south of Davis Lake to accelerate hiding cover in the Key Elk Management Area, and the riparian reserve along Odell Creek. Reforestation will include planting and natural regeneration. Fuel reduction units were located to reduce the risk of fire spreading from high-use areas such as the campgrounds on Davis Lake and along Highway 46. Additional fuels reduction units are located around the periphery of the fire, and in conjunction with previously-treated stands to provide protection from fire entering the recovery area, or conversely, they provide protection for remaining habitat and LOS stands should a fire begin within the recovery area. These small-diameter fuels treatments include green trees up to 12” dbh except in spotted owl nesting, roosting, and foraging habitat where the diameter limit is 6”.

The following table displays the proposed activities in Alternative B. Measurements (acres and miles) are approximate. Refer to Appendix A for a list of units.

Table 2.2 Alternative B Summary

Commercial Salvage (acres)	
Ground-based	3,785
Skyline	800
Helicopter	1,770
Total	**6,355**
Reforestation (acres)	
Conifer Planting within Salvage Units	6,355
Conifer Planting outside Salvage Units	1,675
Lodgepole Planting in Key Elk Area	200
Riparian Reserve Planting along Odell Creek	170
Total	**8,400**
Fuels Treatments and Reductions (acres)	
Small-diameter reductions outside of salvage units (live & dead)	1,450
Road Management (miles)	
Temporary Road Development	11.0

Units for which temporary road construction is anticipated: 40, 70, 80, 81, 90, 100, 125, 135, 136, 155, 160, 180, 185, 190, 192, 205, 210, 215, 220, 230, 245, 247, 255, 256, 260, 266, 270, 300, 305, 310, 315, 320.

Alternative C

Alternative C was developed to respond to Key Issue #1 (Effects to Soils). The area to be salvage harvested is the same as Alternative B, but differs in the logging system utilized. Using aerial harvest systems over more ground (over 3,200 acres), less soil disturbance will occur and less temporary road construction will be required. The post-salvage fuels treatments in the helicopter and skyline units differ from ground-based units because they will not be grapple piled. In ground units, post-salvage fuels treatments would take place by felling unmerchantable 3-12" dbh trees, then grapple piling and burning. In helicopter and skyline units, small-diameter fuels treatments following salvage operations would take place by felling unmerchantable trees 3 – 12" dbh and jackpot burning to reduce concentrations of dead and down material. This burning would be applied to about 60% of each unit. All other activities such as reforestation and fuels reduction outside of salvage units will occur as described in Alternative B.

The following table displays the proposed activities in Alternative C. Measurements (acres and miles) are approximate. Refer to Appendix A for a list of units.

Table 2.3 Alternative C Summary

Commercial Salvage (acres)	
Ground-based	3,130
Skyline	190
Helicopter	3,035
Total	**6,355**
Reforestation (acres)	
Conifer Planting within Salvage Units	6,355
Conifer Planting outside Salvage Units	1,675
Lodgepole Planting in Key Elk Area	200
Riparian Planting along Odell Creek	170
Total	**8,400**
Fuels Treatments and Reductions (acres)	
Small-diameter reductions outside of salvage units (live & dead)	1,450
Road Management (miles)	
Temporary Road Development	9.0

Units for which temporary road construction is anticipated: 40, 70, 80, 81, 100, 125, 135, 136, 155, 160, 180, 185, 190, 192, 205, 220, 230, 245, 247, 255, 256, 260, 266, 270, 320.

Alternative D

Alternative D was developed to respond to Key Issue #3 (Passive Recovery in Late Successional Reserve vs. Recovery using Active Management, Including Commercial Salvage) and Key Issue #2 (Wildlife Habitat). Because some respondents believe that passive management of the forest (or limited intervention) is best for post-fire landscapes, Alternative D proposed no commercial salvage operations, except hazard tree removal along 3 major roads, within the Davis Late Successional Reserve (LSR), where the primary objective is to manage for species that depend on late and old forests. Within the Davis LSR hazard tree removal proposed along roads 6230, 6240, and 6245 would provide for public safety. These roads total approximately 9 miles within the fire area.

Outside of the Davis LSR, commercial salvage and reforestation would take place as identified in Alternatives B & C (approximately 1,045 acres). This would occur in the Matrix allocation (945 acres) as well as outside of the range of the northern spotted owl (100 acres). Small-diameter fuels reductions will take place on approximately 1,750 acres. Some units that are identified for salvage in Alternatives B & C will be treated only for small-diameter fuels in Alternative D (these occur along Highway 46); this accounts for the greater number of acres of fuels reduction in this alternative.

The following table displays the proposed activities in Alternative D. Measurements (acres and miles) are approximate. Refer to Appendix A for a list of units

Table 2.4 Alternative D Summary

Commercial Salvage (acres)	
Ground-based	850
Skyline	195
Helicopter	0
Total	**1,045**
Reforestation (acres)	
Conifer Planting within Salvage Units	1,045
Conifer Planting outside Salvage Units	615
Lodgepole Planting in Key Elk Area	200
Riparian Planting along Odell Creek	170
Total	**2,030**
Fuels Treatments and Reductions (acres)	
Small-diameter reductions outside of salvage units (live & dead)	1,750
Road Management (miles)	
Road Closure	3.0

Units for which temporary road construction is anticipated: 255, 256, 260, 266, 270, 300, 310, 315, 320.

Alternative E

This alternative also responds to the Soils Key Issue #1. The skyline and helicopter harvest units from Alternative C are retained in this alternative, but as helicopter logging only. Ground-based salvage units along Highway 46 from Alternative C are included as helicopter logging units in this alternative. Reforestation of the salvage units will occur. Hazard tree removal would also take place as in the other alternatives. No temporary road construction would be required. Small-diameter fuels treatments following salvage operations would take place by felling unmerchantable trees 3 – 12" dbh and jackpot burning to reduce concentrations of dead and down material. This burning would be applied to about 60% of each unit.

Reforestation by planting outside of salvage units will occur over 250 acres that are within the larger blocks of salvage; and in the Key Elk Area and along Odell Creek as described in the other action alternatives. Fuels reduction outside of salvage units would take place on 1,450 acres by felling understory live trees up to 12 inches in diameter, followed by either grapple piling or hand piling and burning.

Mitigation specific to this Alternative: Units 5 and 10 on Ranger Butte are dropped from logging (approximately 160 acres) in this alternative, as are any other areas exceeding 25% slope.

The following table displays the proposed activities in Alternative E. Measurements (acres and miles) are approximate.

Table 2.5 Alternative E Summary

Commercial Salvage (acres)	
Ground-based	0
Skyline	0
Helicopter	3,290
Total	**3,290**
Reforestation (acres)	
Conifer Planting within Salvage Units	3,290
Conifer Planting outside Salvage Units	250
Lodgepole Planting in Key Elk Area	200
Riparian Planting along Odell Creek	170
Total	**3,910**
Fuels Treatments and Reductions (acres)	
Small-diameter reductions outside of salvage units	1,450
Road Management (miles)	
Temporary Road Development	0

Mitigation and Resource Protection Measures

These design features, as well as the following mitigation measures, are an integral part of each of the action alternatives. They are listed here separately to avoid repeating them in each alternative description.

The effectiveness of each measure is rated at high, moderate, or low to provide a qualitative assessment of expected effectiveness that the implemented practice will have on preventing or reducing impacts on resources. These mitigation measures and design elements are considered in the effects discussions of Chapter 3.

Effectiveness ratings of High, Moderate or Low are based on the following criteria: a) Literature and Research, b) Administrative Studies (local or within similar ecosystem), c) Experience (judgment of qualified personnel by education and/or experience, d) Fact (obvious by reasoned, logical, response).

High: Practice is highly effective (greater than 90 %), meets one or more of the rating criteria, and documentation is available.

Moderate: Documentation shows that practice is 75 to 90 percent effective; or Logic indicates that practice is highly effective, but there is no documentation. Implementation and effectiveness of this practice needs to be monitored and the practice will be modified if necessary to achieve the mitigation objective.

Low: Effectiveness is unknown or unverified, and there is little or no documentation; or applied logic is uncertain and practice is estimated to be less than 60 percent effective. This practice is speculative and needs both effectiveness and validation monitoring.

Wildlife

Northern Bald Eagle

1. No human disturbance within ¼ mile non line-of-sight or ½ mile line-of-sight (1/2 mile for helicopter use and 1.0 mile for blasting) of known bald eagle nests between January 1 and August 31. This condition may be waived in a particular year if nesting or reproductive success surveys reveal that bald eagles are non-nesting or that no young are present that year. Waivers are valid only until January 1 of the following year. **This applies to the following units: 15, 81, 82, 83, 100, 106, 120, 125, 136, 145, 146, 333, 360, 361, 370, 415.** Additional units within ½ mile include: 20, 80, 83, 85, 90, 105, 110, 130, 132, 147, 150, 151, 330, 331, 332, 334, 361, 420. This may change depending on results of 2004 surveys, and yearly monitoring of eagles in and adjacent to the project. *High*
2. Project activities that have the potential to disturb bald eagle winter roosts shall be restricted within ¼ mile of the roosting area from November 1 to April 30th. *Moderate*
3. Retain a strip of eagle perch trees along the lakeside boundary of units adjacent to the lake. These structures are generally greater than 20 inches dbh with a branch or top structure large enough to support an eagle and provide an unobstructed view of the lake. **This applies to units 15, 20, 120, 350, 355, and 370.** *Moderate*
4. Place no cut buffers of at least 200 feet around winter roost sites and historic nest trees still intact that were burned over. Buffers need to preserve microsite characteristics and can be variable in size. District wildlife biologist will supervise placement of buffers. *Moderate*
5. Prescribed fire managers need to use smoke management forecasts in order to minimize smoke entering into suitable habitat and to ensure that dissipation would be adequate. *Moderate*

Northern Spotted Owl

6. Surveys will be completed spring 2004 on all existing habitat and former home ranges. *Moderate*

7. Disruptive work activities will not take place within ¼ mile (1/2 mile for helicopter use and 1.0 mile for blasting) of the nest site or activity center of all known pairs or resident singles between March 1 and September 30. This condition may be waived in a particular year if nesting or reproductive success surveys reveal that spotted owls are non-nesting or that no young are present that year. Waivers are valid only until March 1 of the following year. **This applies to the following unit: 175 and may include additional units depending on the results of 2004 surveys. This may change as a result of monitoring of owl habitat in and adjacent to the project area.** *Moderate*
8. Untreated clumps would be left scattered across the NRF portions of fuel treatment units. Clumps would be approximately 0.25 acres in size and average 0.5 clumps per acre. **This applies to units 331, 370, and 390.**

Big Game

9. Minimize disturbance to fawning/calving areas by restricting activities within ¼ mile of riparian areas from May 1 through June 30. This applies to units 5, 15, 20, 65, 66, 81, 105, 106, 120, 150, 335, 340, 345, 350, 355, 361, 370, 410 and 415. *Moderate*

Soils and Water

Harvest and Fuels Treatment Operations

10. Use harvest methods designed to lessen impacts on the soil resource, including some or all of the following:
    a. Use existing logging facilities or designate locations for new skid trails and landings
    b. Restrict skidders to trails and limit off trail travel of other harvest equipment to two or fewer passes
    c. Limit use of ground-based mechanized equipment on slopes greater than 30 percent, longer than 200 feet and making up more than 10 percent of the unit. If larger areas with slopes greater than 30 percent occur, they will be evaluated with the soil scientist prior to harvest.
    d. Minimize maneuvering of off-trail machine traffic during times of year when soils are extremely dry and subject to excessive soil displacement, generally in the summer months of July, August and September.
    e. Hand-fell and skyline or helicopter yard material within activity units having slopes exceeding 30% and located immediately adjacent or upslope of RHCA or Riparian Reserves along intermediate or perennial stream reaches.
11. Specific to Alternative E only: Units 5 and 10 on Ranger Butte are dropped from logging (approximately 160 acres) in this alternative, as are any other areas exceeding 25% slope.
12. Riparian Reserves are excluded from commercial timber harvest. (BMP T-2)
13. In all units, location of skid trails and landings would be agreed upon prior to the logging and/or fuels operations. Skid trails, landings and temporary roads would be rehabilitated as needed to meet the 20% standard for detrimental conditions following salvage and fuels treatments. Maintain spacing of greater than 100 feet for all primary (main) skid trail routes, except where converging toward landings. Closer spacing of skid trails due to complex terrain is to be approved in advance by the Timber Sale Administrator. No landings will be allowed in Riparian Reserves or RHCAs (LRMP SL-1 & SL-3; Timber Management BMP T-10, T-11, T-14 & T-16). *Moderate*
14. Promote the harvest and yarding of merchantable material in ground-based salvage units during winter season conditions that can provide frozen ground and/or snow cover sufficient to reduce direct mechanical impacts to the soil resource.
15. Use old landings and skidding networks whenever possible. Assure that water control structures are installed and maintained on skid trails that have gradients of 10 percent or more. Ensure erosion control

structures are stabilized and working effectively (LRMP SL-1; Timber Management BMP T-10, T-16, T-18). High effectiveness.

16. Protect Soils and Water resources by piling the majority of slash to be burned on existing areas of detrimental compaction such as skid trails or landings in order to reduce incurring additional detrimental impacts between skid trails. Promote the use of grapple piling machinery capable of operating from skid trails and landings used during harvest operations. Promote the use of hand-piling of slash located between skid trails and out of reach of grapple machinery. Limit off-trail traffic of any machinery used for piling to two or fewer passes (Fuels Management BMP F-3; Timber Management BMP T 11, 13) *Moderate-high*
17. Coarse Woody Debris/Down Wood - Assure that on Ponderosa Pine sites, a minimum of 3 to 5 tons per acre of large woody debris (greater than 3-inches in diameter) is retained within activity areas for long-term site productivity (LRMP SL-1). Assure that on Mixed Conifer sites, a minimum of 5 to 10 tons per acre of large woody debris (greater than 3-inches in diameter) is retained within activity areas for long-term site productivity (LRMP SL-1). *Moderate*
18. Use sale area maps for designating soil and water protections needs (Timber Management BMP T-4). *Moderate*

Temporary Roads and Landings

19. All temporary roads and landings will be located outside Riparian Reserves or RHCAs. Locate road beds to landings within unit boundaries on skid trails used or created by salvage operations (Road BMP R-1) *High*
20. All temporary roads will be rehabilitated by ripping and/or tilling, have water bars installed where necessary, and be closed immediately following post-harvest operations to restore hydrologic function. (Road BMP R-23). *High*
21. Surface Drainage – minimize erosive effects of concentrated water and the degradation of water quality through the proper construction of temporary roads (Road BMP R-7). *Moderate*
22. Maintenance – conduct regular preventive maintenance to avoid deterioration of the road surface and minimize the effects of erosion and sedimentation (Road BMP R-18, R-19). *Moderate-high*

Unit-Specific Mitigation Measures

23. Locate designated skid trails and log landings on well-drained sites, upslope from toe and lower foot slope locations capable of contributing sediment. Restrict equipment operations to existing roads and designated logging facilities at all times. Exceptions would be subject to Forest Service approval. *High*

    Objective: Protect or maintain the quality of soil properties and shallow rooted vegetation by controlling equipment operations to locations and conditions that are less susceptible to soil puddling and compaction damage. Confine multiple pass equipment impacts to designated areas that can be mitigated following harvest and post-harvest activities.
24. Restrict mechanical disturbance on slopes greater than 25 percent to designated areas (i.e., existing roads and landings) within proposed ground-based activity units at all times and promote the designation of wildlife retention areas to incorporate these areas. Exceptions for ground travel would be subject to Forest Service approval. Assure that water control structures are installed and maintained on skid trails that have gradients of 10 percent or more. Machine piling of slash would not be authorized off of designated skid trails in activity areas that contain slopes over 25 percent. *High*

    Objective: Reduce displacement and compaction damage to soils by limiting equipment operations to specified areas and ground conditions.
25. Reclaim temporary roads, and, in activity areas where detrimental soil conditions are expected to exceed 20% of unit area, log landings and primary skid trails by applying appropriate rehabilitation. Decommission (obliterate) logging facilities that will not be needed for future management. Proposed activity units 35,151,167,180,192,200,205,210,215,249,265,290,291,305,310,315,320,400,410 and 415 are predicted to exceed the 20 percent limit in detrimental soil conditions following the mechanical

treatments proposed with this project. Some proposed activity units would require temporary road construction in order to implement log hauling from landings located in the interior of ground-based units. *High*

Objectives: Reduce the extent of detrimentally disturbed soil to meet management objectives. Restore and stabilize detrimentally disturbed soils prior to seasonal runoff events. Prevent concentration of overland flow and reduce the risk of accelerated erosion and sedimentation.

Options for mitigating the effects of project activities include the use of subsoiling treatments to relieve compacted soils, redistributing humus-enriched topsoil in areas of soil displacement, re-contouring cut-and-fill slopes on excavated skid trails, and pulling available slash and woody materials over the treated surface to establish effective ground cover protection.

Riparian Reserves and Riparian Habitat Conservation Areas

Riparian buffers have been utilized across the region on timber harvest projects as a means to protecting water bodies and areas prone to instability. The Davis Fire Recovery Project does not involve any salvage units adjacent to perennial streams, but units are located near Davis Lake.

26. No commercial timber harvest will occur within 300 feet of the high water mark (indicated by the timberline) of Davis Lake. *High*
27. No commercial timber harvest will occur within 300 feet of perennial streams (Ranger Creek and Odell Creek). *High*
28. No ground-based machinery is allowed off of existing roads within Riparian Reserves. *High*
29. No new or temporary roads will be located within the Riparian Reserves. *High*
30. All log decks and landings shall be located outside of Riparian Reserves or RHCAs. *High*
31. Where Forest Road 4660 crosses Odell Creek, if hauling occurs during the rainy season, (April to July), filter cloth fencing is required in adjacent roadside ditches, 25 feet from the stream channel. *Moderate*

Recreation Resources

32. Within or near affected developed recreation sites, operations may be restricted on weekends and holidays during the summer recreation season. This would apply during the summer recreation season, which is considered to be from Memorial Day weekend through Labor Day weekend. *Moderate*
33. Before, during, and after the operating season for the developed campgrounds around Davis Lake there will be a field ranger, recreation personnel or camp hosts visiting with campers, informing them of the hazards that exist outside of the campground perimeter. *Moderate*
34. All precautions will be taken to prevent forest users from entering hazardous areas. A fence or some kind of barrier will be installed to define campsites within the campground to increase safety. *Moderate*
35. For areas visible from campgrounds around Davis Lake, specification requirements will be no stumps over 6 inches high. *High*
36. 100% cleanup of activity fuels around developed sites. *High*

Recommendations

37. Interpretive signs and handout materials should be made available to the public, informing them of harvest activities in the adjacent areas. *Moderate*
38. With the decrease in the amount of ground cover and fuels within the campground and roads surrounding the sites, an increase of off-highway vehicle use is expected. Law enforcement may need to be increased to prevent resource damage. *Low*

Cultural Resources

39. A data recovery/treatment/rehabilitation plan has been drafted in consultation with appropriate American Indian tribes and the State Historic Preservation Office. These treatments will serve as mitigation of otherwise adverse effects on eligible sites where adverse impacts are anticipated. Due to the sensitivity of site locations, these measures will not be addressed here. Site specific mitigation measures proposed for adverse effects are included in the consultation report, and will vary according to site location, character, and proposed treatment. *Moderate-Low*

Noxious Weeds

Mitigations for the Davis Fire Recovery Project are taken from the Guide to Noxious Weed Prevention Practices and from Deschutes National Forest Integrated Weed Management Plan. The mitigations listed below have been evaluated and have been determined to be effective, feasible, and cost-effective.

Objectives/Mitigation Measures, and Management Requirements

40. For timber sale contracts, road packages, stewardship pilot projects, and service contracts, include provisions to minimize the introduction and spread of Invasive Plants pursuant to Executive Order 13112 dated February 3, 1999 (Joyner 2002). *High*
41. Before ground-disturbing activities begin, inventory and prioritize weed infestations for treatment in project operating areas and along access routes. Control weeds as necessary. *Moderate*
42. To reduce the risk of spreading weed infestations, begin project operations in uninfested areas before operating in weed-infested areas. *Moderate*
43. Determine the need for, and when appropriate, identify sites where equipment can be cleaned. Clean equipment before entering National Forest System lands. Remove mud, dirt, and plant parts from project equipment before moving into the project area. *Moderate*
44. Clean all equipment before leaving the project site, if operating in areas infested with weeds. *Moderate*
45. Coordinate project activities with any nearby herbicide application to maximize cost effectiveness of weed treatments. *High*
46. Evaluate options, including closure, to regulate the flow of traffic on sites where desired vegetation needs to be established. Sites could include roads and trails, and other areas of disturbed soils. *High*
47. Retain native vegetation in and around project activity areas to the maximum extent possible consistent with project objectives. *High*
48. Inspect and document all limited term ground-disturbing operations in noxious weed infested areas for at least three (3) growing seasons following completion of the project. For ongoing projects, continue to monitor until reasonable certainty is obtained that no weeds have been introduced. Provide for follow-up treatments based on inspection results. *Moderate*
49. Provide information, training, and appropriate weed identification materials to people potentially involved in weed introduction, establishment, and spread on National Forest System lands. Educate them to an appropriate level in weed identification, biology, impacts, and effective prevention measures. *Low*
50. Ensure that equipment used in fuels reduction and prescribed burning activities for this project are free of weed seed and propagules before moving into the project area. *High*
51. Ensure that all government owned equipment and vehicles used on the Davis Fire Recovery Project activities are clean and free of dirt, seeds, and other plant propagules. *Moderate*

Scenery Resources

Objectives/Mitigation Measures, and Management Requirements

Along 300' in Foreground designation along Highway 46:

52. Minimize visibility of stumps by cutting a maximum of 6" from ground height. *High*
53. Facilitate hand piling and disposal of activity-generated tops and limbs (slash) within one year after treatment. It is desirable but not required to maintain small piles if prescribed burning is the method for disposal. *High*
54. Design and locate skid trails and landing areas at least 100 feet from the primary travel corridor. *Moderate*

For all other major travelways (Highway 46, 4660, 62, and 6220):

55. Minimize visual evidence of tree marking paint by applying to the backsides of trees designated for retention. *High*
56. Remove ribbons and other timber harvest markers as part of post treatment activity following the completion of the project. *High*

Air Quality

57. The objective is to minimize human-caused visual impacts to the Class 1 airshed (Diamond Peak Wilderness). Prescribed burning operations would be restricted during the period of July 1 – September. Also, prescribe burn operations to dissipate smoke away from the Class 1 airshed (i.e. burn during forecasted westerly winds). *High*
58. Warning signs will be posted at prominent road junctions to inform the public of prescribed burning operations, and will remain in place until there is no visible smoke. If feasible, roads may be temporarily closed for the protection of public safety. *Moderate*
59. As part of the plan to inform the public, notify local businesses prior to the burning season and on the day of planned prescribed burning operations. Also, notify adjacent landowners of burning operations conducted in units within ¼ mile of their property. *Moderate*
60. Reduce particulate emission through utilization to the extent practical (i.e. pulling trees to the landing with limbs attached and biomass utilization versus prescribed burning). *Moderate*

Monitoring

Project monitoring focuses primarily on "implementation monitoring" to assure the selected alternative and mitigation measures are implemented on the ground as designed and achieve the desired results.

Late Successional Reserve

Objective To determine if selected elements desired for Late Successional Reserve recovery are achieved in the timeframes expected.

Monitoring Elements Snag persistence, fuels hazard, noxious weeds, *Tritomaria exsectiformis*, conifer regeneration success by species, insect availability for dependent avian species.

Area of Consideration It is expected a study plan with appropriate monitoring criteria would be developed prior to implementation of the selected alternative. Establish at least 20 photopoints within the fire perimeter and LSR stratified by plant association group, topography, control versus non-control, fire severity, and fire intensity. Locate plots to collect the following information:

Snags and down wood – Is the fall rate and persistence of snags greater than 20" dbh affected by adjacent salvage activities? What is the fall rate in various environmental conditions including aspect, topography, and elevation by species?

Fuels – What is the fuel profile and is it within parameters that would allow future application of prescribed fire within appropriate areas (i.e. 15-25 tons per acre)? Use methods that allow efficient data collection such as photo series.

Noxious Weeds – Are existing infestations expanding and are there new infestations of invasive plant species? What are the techniques being implemented to prevent the introduction of new infestations and control the expansion of existing populations?

Tritomaria exsectiformis – Is this Survey and Manage liverwort occurrence maintaining persistence and vigor?

Conifer establishment – Evaluating both natural and planted conifers, are we achieving rates of growth and species diversity desired for late successional objectives? In appropriate areas, are we on track for careful introduction of prescribed fire at year 40?

Insect availability – What is the foraging potential and insect availability by species that colonize standing and down dead wood at various times through successional stages? Stratify by snag density, location, size, and species.

Suggested Methodology 1) Annual field observance by appropriate personnel in coordination with counterparts in the Supervisor's Office. It is expected that one to two individuals could accomplish the observations within one to two workdays. 2) Establish photo points in locations that are easily accessible. Use Global Positioning technology. 3) Information would be collected and stored by the Crescent Ranger District.

Soil Quality

Objective To determine if post-implementation soil productivity is within parameters consistent with regional standards and guidelines for soil quality.

Monitoring Elements Percentage of detrimental disturbance.

Area of Consideration Treatment units stratified by harvest method.

Suggested Methodology 1) Sample using transects to determine detrimental disturbance within areas of activity.

Scenic Views Monitoring

During layout and following completion within one year, utilize a Landscape Architect to monitor compliance with measures, such as tree marking and placement of landings and skid trails along Highway 46 and orientation of skyline corridors to maintain scenic attributes.

Cultural Resource Monitoring

Historic and archaeological site monitoring would occur for sites that are flagged for avoidance and excluded from units or treatments within them. Monitoring would also be prescribed to follow the results of treatment activities. A list of all the sites and their specific monitoring needs will be included in the cultural resource inventory/consultation report for the Davis Fire Recovery Project. Part of the monitoring would occur through coordination with other specialists. Monitoring will also occur after the cultural resource treatment plan is implemented, especially where proposed actions provide the opportunity to examine buried deposits.

Noxious Weeds

Objective To determine the introduction of new infestations or expansion of existing infestations of invasive plant species.

Monitoring Elements Area covered by infestations and their locations.

Area of Consideration Davis Fire Area in the Davis Late Successional Reserve

Suggested Methodology Inspect fire line and travel routes annually during field season.

Riparian Vegetation

Seven photopoints were established along Odell Creek between the mouth and Forest Road 4660. These photopoints were installed as recommended by the BAER Team to monitor vegetative recovery within the riparian area. The sites will be visited twice within the first 12 months.

Key Elk Area

Monitor the lodgepole flats area for two years following the fire for natural regeneration around the areas designated for big game cover. Adequate reforestation will be identified as seedlings showing on 60% or more of the area at a level greater than 150 trees per acre. If adequate natural regeneration is not apparent planting will occur.

Sale Area Improvement Projects

Money may be collected from the timber sales to complete certain projects such as required reforestation, identified mitigation, enhancement and restoration projects in the vicinity of the salvage timber sale areas. Required reforestation items (R) and mitigation measures (M) have the highest priority for funding, but may be funded by other means such as appropriated funds to insure that requirements are accomplished. Items marked with an (E) are considered Enhancement.

This list is intended to serve as an overall guide for the analysis area. As specific timber sales are delineated within the project area, specific priorities may be adjusted to meet the needs for each sale area. This priority setting should be documented briefly in the implementation file for each timber sale.

Projects listed here that are not analyzed as part of this project will require documentation through a separate NEPA process.

1. Reforestation Site Preparation (Subsoiling) (R)
2. Subsoiling (M)
3. Reforestation planting and surveys (E)
4. Reforestation Animal Damage Control (E)
5. Fuels Reduction in Salvage Units (E)
6. Fuels Reduction Outside Salvage Units (E)
7. Reforestation outside Salvage Units (E)
8. Noxious weed Control (E)
9. Riparian Planting (E)
10. Cultural Resource Site Protection (E)
11. Road Decommissioning/Closure (E)
12. Guzzler Replacement (E)
13. Rare Plant Site Enhancement (E)
14. Bitterbrush Planting, Key Elk Area (E)
15. Lodgepole Reforestation, Key Elk Area (E)
16. Recreation Site Cleanup (E)
17. Recreation Site Improvement (E)
18. Subsoiling (E)

Comparison of Alternatives

This section provides several tables that summarize and compare the alternatives by how each responds to the purpose and need; how each responds to the key issues and the related effects on the key issue indicators; and by the activities proposed.

Table 2.6 Comparison of the Activities by Alternative

Action	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
Commercial Salvage (acres)	**0**	**6,355**	**6,355**	**1,045**	**3,290**
Logging Systems (acres)					
Ground-Based	**0**	**3,785**	**3,130**	**850**	**0**
Skyline	**0**	**800**	**190**	**195**	**0**
Helicopter	**0**	**1,770**	**3,035**	**0**	**3,290**
Fuels Reduction (acres)	**0**	**1,450**	**1,450**	**1,750**	**1,450**
Reforestation (acres)	**0**	**8,400**	**8,400**	**2,030**	**3,910**
Temporary Road Construction	**0**	**11.0**	**9.0**	**3.0**	**0**

Table 2.7 Comparison of How Each Alternative Responds to the Purpose and Need

Purpose and Need ↓	Alternative A No Action – Continuation of current management	Alternative B Greatest amount of ground based salvage & fuels reduction	Alternative C Same as B, but more aerial harvest systems for salvage	Alternative D No salvage or reforestation in LSR	Alternative E Helicopter salvage only
Protect Remaining Late/Old Habitat in LSR and Matrix from future uncharacteristically severe fire					
Increase suppression effectiveness and reduce the potential risk of high severity fire effects associated with subsequent fires.	At year 30-60, biomass projections for untreated stands range from 60-90 tons per acre. Fire intensity (>4' flame lengths), spread rate, and resistance to control are considered high.	At year 30-60, within 6,355 acres of treated units, biomass projections range from 30-60 tons per acre. Greater potential for control due to a lower fire intensity (4' or less flame length during moderate conditions), and less resistance to control as a result of down logs in key areas.	At year 30-60, within 6,355 acres of treated units, biomass projections range from 30-60 tons per acre. Greater potential for control due to a lower fire intensity (4' or less flame length during moderate conditions), and less resistance to control as a result of down logs in key areas.	At year 30-60, within 1,045 acres of treated units, biomass projections range from 30-60 tons per acre. Greater potential for control due to a lower fire intensity (4' or less flame length during moderate conditions), and less resistance to control as a result of down logs in key areas.	At year 30-60, within 3,290 acres of treated units, biomass projections range from 30-60 tons per acre. Greater potential for control due to a lower fire intensity (4' or less flame length during moderate conditions), and less resistance to control as a result of down logs in key areas.
Protect the Matrix lands that have increased importance on the landscape for providing a refuge for species associated with late and old structured stands.	Greatest risk to Matrix lands due to the lowest potential for suppression effectiveness. No change would occur in the fuel profile within and surrounding areas. Regular custodial wildfire suppression policies would continue.	This alternative and Alternative C affords the greatest protection due to an integrated approach to biomass reduction associated with large and small diameter fuel reduction.	This alternative and Alternative B affords the greatest protection due to an integrated approach to biomass reduction associated with large and small diameter fuel reduction	Least protection of matrix lands of action alternatives due to biomass reduction on adjoining LSR lands limited in extent and location.	Very similar in protection of Matrix lands due to an integrated approach to biomass reduction associated with large and small diameter fuel reduction to a lesser extent than in Alternatives B and C.
Protect remaining suitable habitat within the LSR by reducing fuels within and around the fire perimeter.	Greatest risk to remaining habitat within LSR due to the lowest potential for suppression effectiveness. No	This alternative and Alternative C affords the greatest protection due to an integrated approach to biomass reduction associated with large and small	This alternative and Alternative B affords the greatest protection due to an integrated approach to biomass	Least protection of remaining LSR habitat of action alternatives due to biomass reduction limited to fuels reduction of	Very similar in protection of remaining LSR habitat due to an integrated approach to biomass reduction associated with large and small

Purpose and Need ↓	Alternative A No Action – Continuation of current management	Alternative B Greatest amount of ground based salvage & fuels reduction	Alternative C Same as B, but more aerial harvest systems for salvage	Alternative D No salvage or reforestation in LSR	Alternative E Helicopter salvage only
	change would occur in the fuel profile within and surrounding areas. Regular custodial wildfire suppression policies would continue	diameter fuel reduction within and surrounding the LSR perimeter.	reduction associated with large and small diameter fuel reduction within and surrounding the LSR perimeter.	surrounding Matrix lands except for some small diameter fuel reduction within the LSR that is not integrated into reduction of larger fuels.	diameter fuel reduction to a lesser extent than in Alternatives B and C..
Promote the long-term survival and growth of new conifers by bringing fuel loads to a sustainable level for eastside forests that reduces the likelihood of stand-replacement fire in newly regenerated stands, particularly during the early stages of stand development.	Approximately 20 percent of the area would be in a sustainable fuel level.	Fuels treatments would result in approximately 51 percent of the area in a sustainable fuel level.	Fuels treatments would result in approximately 50 percent of the area in a sustainable fuel level.	Fuels treatments would result in approximately 33 percent of the area in a sustainable fuel level.	Fuels treatments would result in approximately 38 percent of the area in a sustainable fuel level.
Establish fuel conditions to allow for future management actions and restore fire as an ecosystem component					
Bring fuel loads to a level that allows reintroduction of fire at the appropriate stages for the vegetation type.	Acres with fuel loadings conducive to application of prescribed fire: 4,230	Acres with fuel loadings conducive to application of prescribed fire: 10,649	Acres with fuel loadings conducive to application of prescribed fire: 10,453	Acres with fuel loadings conducive to application of prescribed fire: 6,906	Acres with fuel loadings conducive to application of prescribed fire: 8,054
Reestablish and restore ponderosa pine habitat including large ponderosa trees using prescribed fire where fuel loads are acceptable.	At age 100, stand is predominantly lodgepole pine. Using prescribed fire would reset the successional stage to "stand initiation". No planting of ponderosa pine would occur.	Fuel loadings would be reduced to facilitate application of prescribed fire on 3,100 acres. Ponderosa pine-dominated habitat would be planted on 597 acres.	Fuel loadings would be reduced to facilitate prescribed fire on 3,100 acres. Ponderosa pine-dominated habitat would be planted on 597 acres.	Fuel loadings would be reduced to facilitate application of prescribed fire on 300 acres. Ponderosa pine-dominated habitat would be planted on 321 acres.	Fuel loadings would be reduced to facilitate application of prescribed fire on 1,800 acres. Ponderosa pine-dominated habitat would be planted on 117 acres.

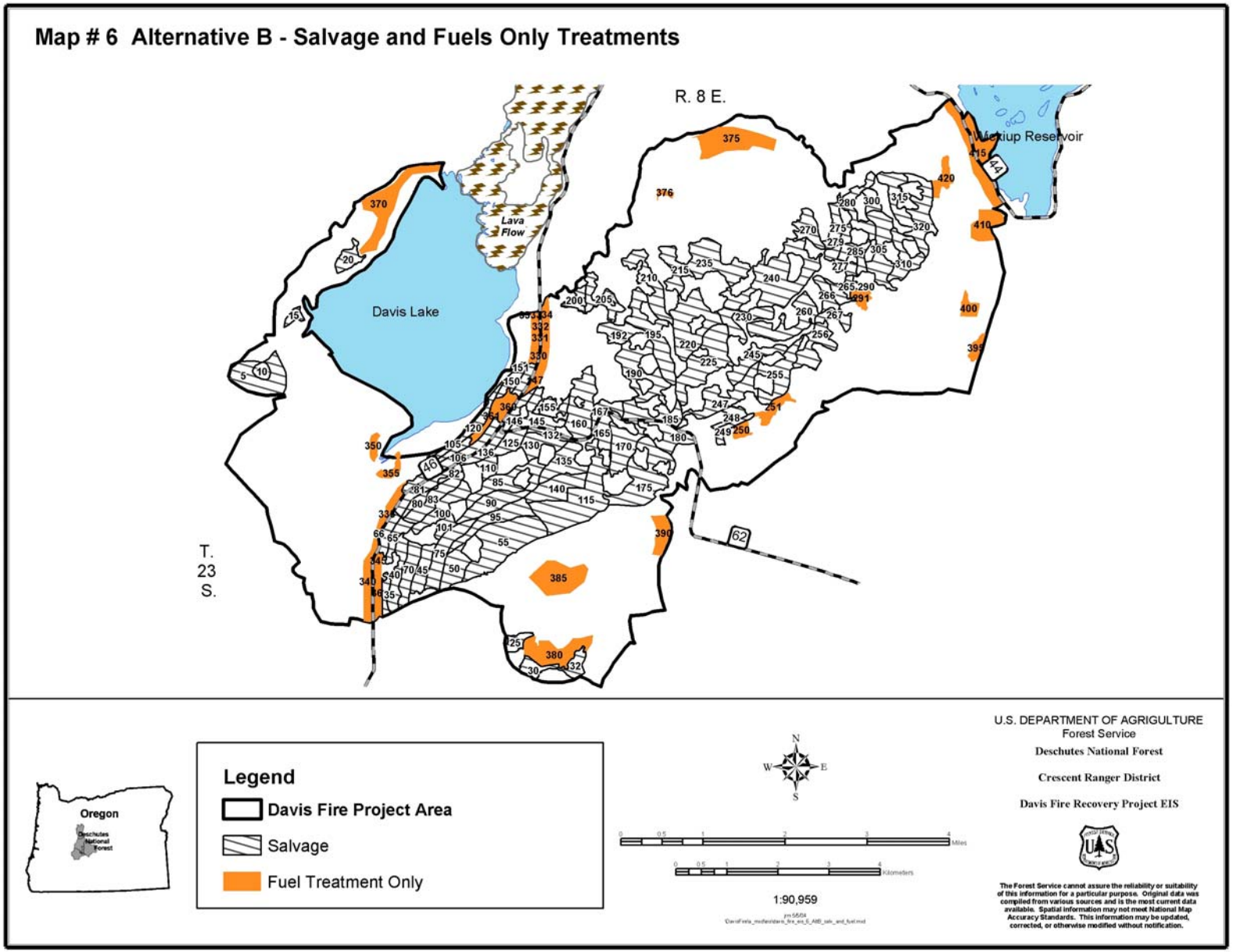
Purpose and Need ↓	Alternative A No Action – Continuation of current management	Alternative B Greatest amount of ground based salvage & fuels reduction	Alternative C Same as B, but more aerial harvest systems for salvage	Alternative D No salvage or reforestation in LSR	Alternative E Helicopter salvage only
Accelerate reforestation of the desired species in areas where no seed source remains; provide habitat to species associated with late and old structured forests					
Ensure timely establishment of Douglas fir and ponderosa pine to meet long-term LSR objectives where seed sources are not available.	Reforestation would occur by natural regeneration only. Stands would be stocked with mostly lodgepole pine for at least 100 years. Snags of suitable size and species would be delayed at least 100 years.	Conifer planting would include Douglas-fir and ponderosa pine seedlings and would occur on 8,030 acres. Average tree diameter would be 14" at year 100.	Conifer planting would include Douglas-fir and ponderosa pine seedlings and would occur on 8,030 acres. Average tree diameter would be 14" at year 100.	Conifer planting including Douglas-fir and ponderosa pine seedlings and would occur on 1,660 acres. Average tree diameter would be 14" at year 100.	Conifer planting including Douglas-fir and ponderosa pine seedlings would occur on 3,540 acres. Average tree diameter would be 14" at year 100.
Provide a future source of habitat in Matrix lands to provide connectivity between LSRs.	In those areas of the fire that removed canopy in Matrix lands, owl dispersal habitat would not be available for approximately 100 years.	In those areas that removed canopy in Matrix lands, owl dispersal habitat would be available in 40 years on 1,660 acres.	In those areas that removed canopy in Matrix lands, owl dispersal habitat would be available in 40 years on 1,660 acres.	In those areas that removed canopy in Matrix lands, owl dispersal habitat would be available in 40 years on 1,660 acres.	In those areas that removed canopy in Matrix lands, owl dispersal habitat would be available in 40 years on 1,660 acres.
Accelerate reforestation in Key Elk Area to provide cover where natural regeneration is not fully successful.	No planting of conifers would occur in Key Elk areas.	Approximately 200 acres of lodgepole pine in the Key Elk Area would be planted if natural regeneration is not successful.	Approximately 200 acres of lodgepole pine in the Key Elk Area would be planted if natural regeneration is not successful.	Approximately 200 acres of lodgepole pine in the Key Elk Area would be planted if natural regeneration is not successful.	Approximately 200 acres of lodgepole pine in the Key Elk Area would be planted if natural regeneration is not successful.
Recover shade in riparian areas more quickly and establish riparian species before lodgepole pine becomes established.	No planting of riparian vegetation would occur.	Approximately 170 acres of riparian planting along Odell Creek would occur.	Approximately 170 acres of riparian planting along Odell Creek would occur.	Approximately 170 acres of riparian planting along Odell Creek would occur.	Approximately 170 acres of riparian planting along Odell Creek would occur.

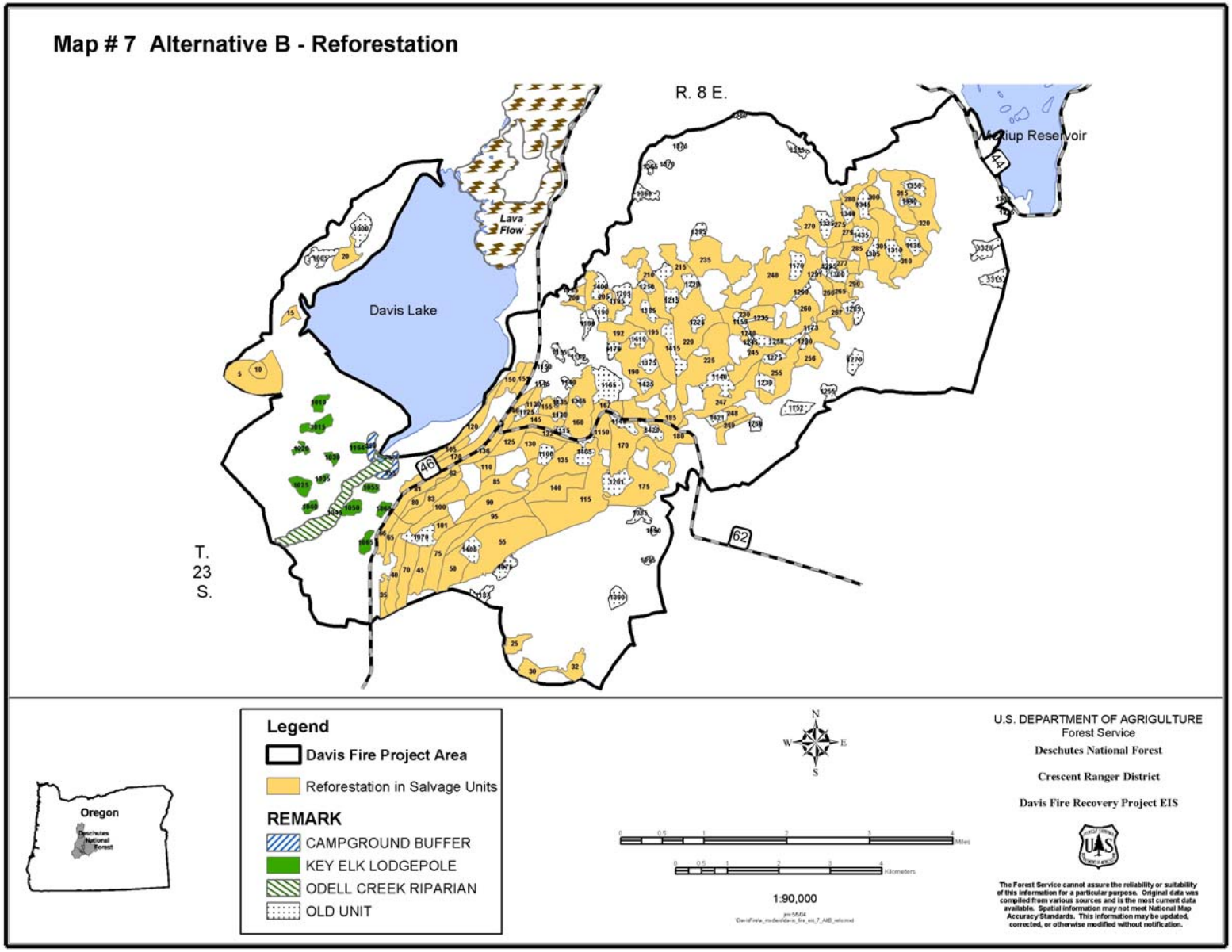
Purpose and Need ↓	Alternative A No Action – Continuation of current management	Alternative B Greatest amount of ground based salvage & fuels reduction	Alternative C Same as B, but more aerial harvest systems for salvage	Alternative D No salvage or reforestation in LSR	Alternative E Helicopter salvage only
Recover the economic value contained in fire-killed trees while meeting LSR and other management objectives					
Salvage merchantable trees in all areas to make the recommended removal of fuels in smaller, unmerchantable size classes economically feasible and to offset costs of reforestation. *Remove fire-killed trees through salvage logging to provide sawtimber and other wood products to the economy.*	No recovery of value in the form of wood products would occur.	Up to 151,071 ccf (84 Million Board Feet) would be recovered in the form of wood products..	Up to 151,071 ccf (84 Million Board Feet) would be recovered in the form of wood products. Only 79 Million Board Feet would be recovered if the market for 12" material is not economically feasible for helicopter operations.	Up to 22,529 ccf (13 Million Board Feet) would be recovered in the form of wood products.	Up to 78,749 ccf (41 Million Board Feet) would be recovered in the form of wood products.
Improve public safety in the fire area					
Reduce hazards associated with danger trees along major roads by removing them.	Danger tree removal on Highway Safety Act roads and within recreation sites only. No danger tree removal on other 4-digit roads in fire area. Davis Fire Area Orange Dot Travel Management System in force to protect safety of forest visitors (orange dots identify roads open to the public).	Danger tree removal on all major roads, including 4-digit roads. Davis Fire Area Orange Dot Travel Management System in force.	Danger tree removal on all major roads, including 4-digit roads. Davis Fire Area Orange Dot Travel Management System in force.	Danger tree removal on all major roads, including 4-digit roads. Davis Fire Area Orange Dot Travel Management System in force.	Danger tree removal on all major roads, including 4-digit roads. Davis Fire Area Orange Dot Travel Management System in force.

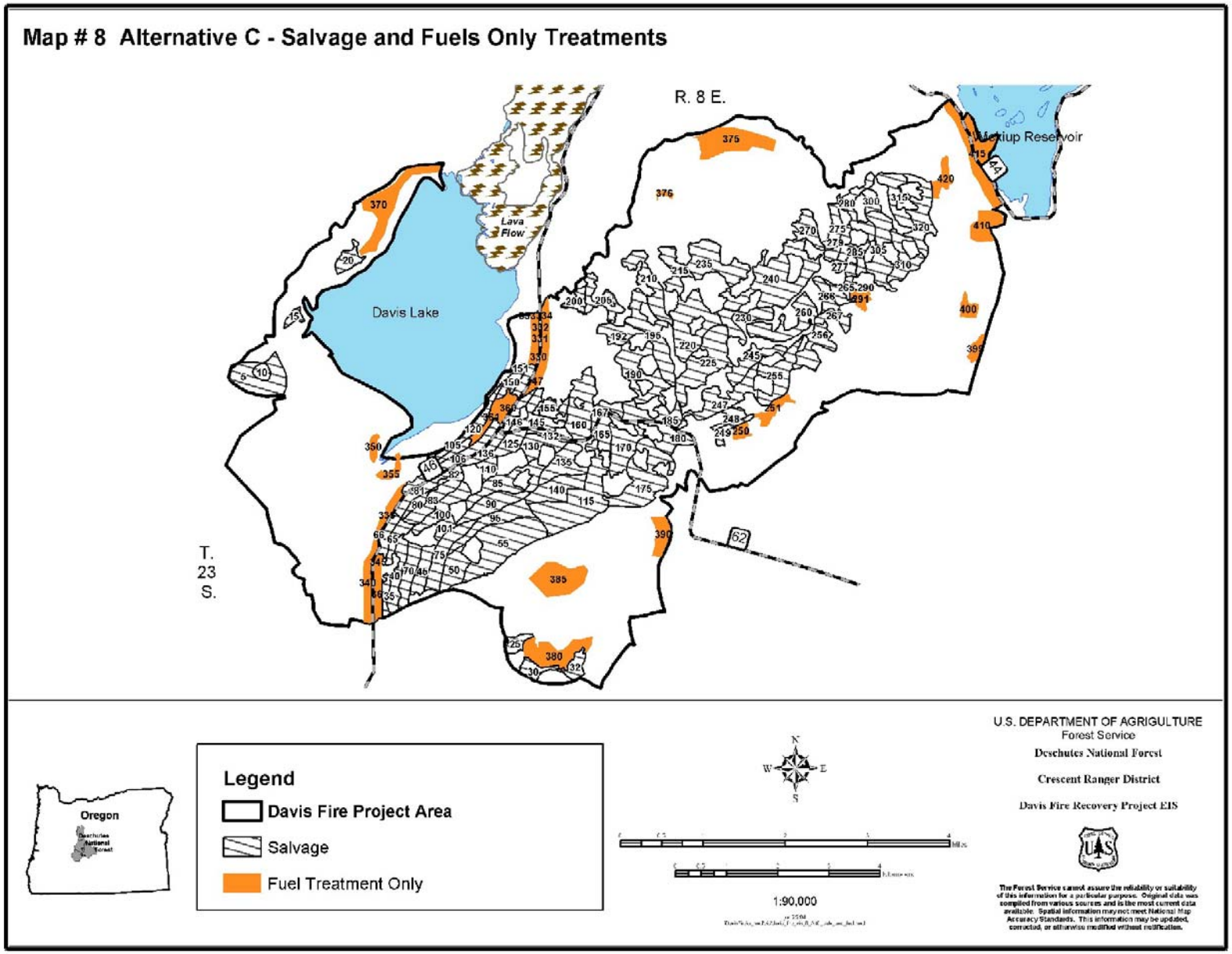
Table 2.8 Comparison of the Alternatives Based on How Each Responds to the Key Issues

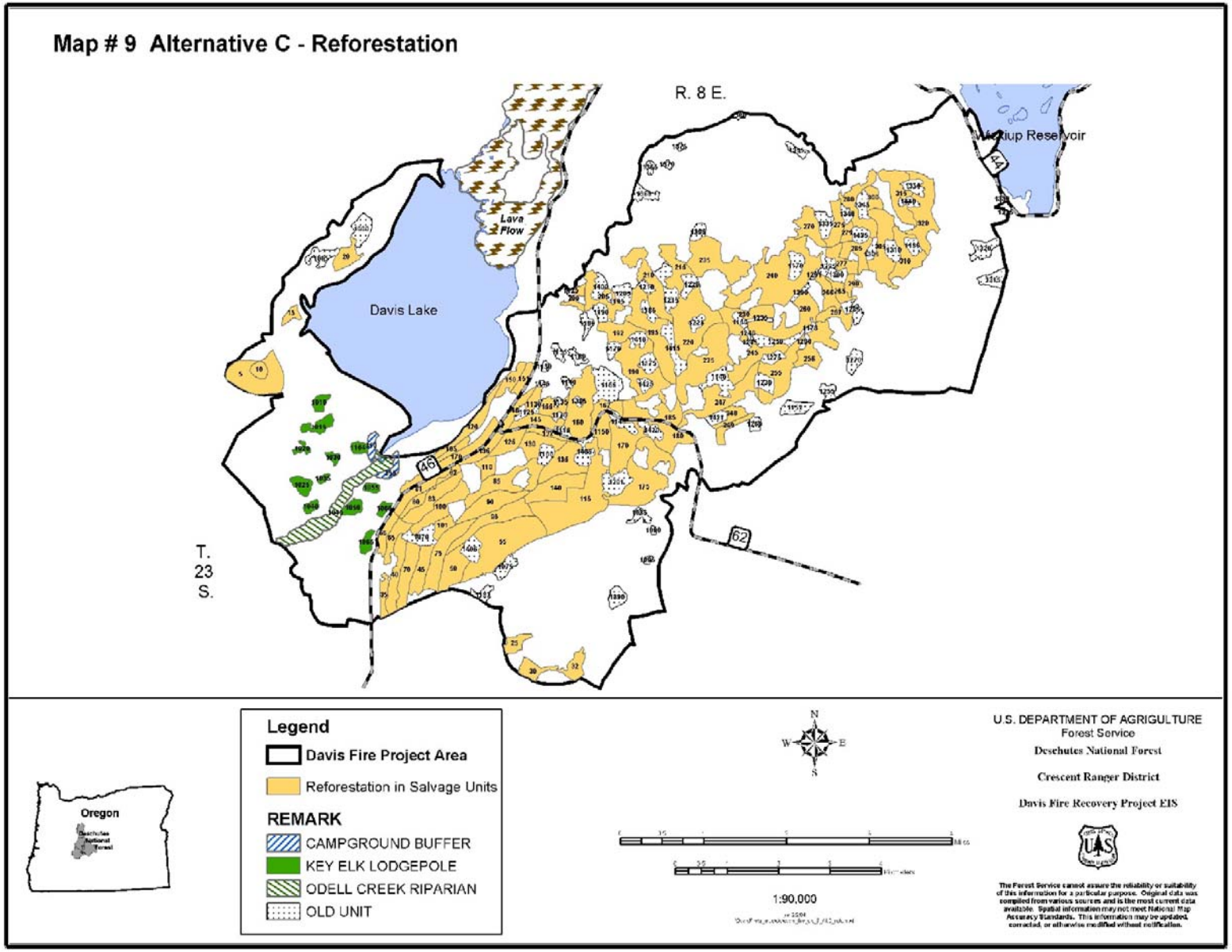
Issue and Indicators	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Impacts to Soils					
Detrimental disturbance, soil productivity effects related to type of logging system *Expected effects of future fire to soils*	No additional detrimental impacts to the soil resource in the short-term. Long-term risks include elevated coarse woody debris levels capable of incurring heat damage during subsequent wildfire events. Approximately 80% of area would exceed 35 tons per acre of biomass.	Alt B would incur the greatest extent of detrimental disturbance by treating 4,850 acres with ground-based systems. Would require 69 acres to be subsoiled for mitigation to meet standard and guidelines. Risk of future soil heating related to approximately 49% of area exceeding 35 tons per acre of biomass.	Alt C would incur slightly lower levels of detrimental disturbance by converting 762 ground-based acres and 610 skyline acres to helicopter yarding. Would require 40 acres to be subsoiled for mitigation to meet standard and guidelines. Risk of future soil heating related to approximately 50% of area exceeding 35 tons per acre of biomass.	Would detrimentally disturb the least amount of total acreage of any of the action alternatives. Would require 19 acres to be subsoiled for mitigation to meet standard and guidelines. Risk of future soil heating related to approximately 67% of area exceeding 35 tons per acre of biomass.	No ground-based harvest. 3,290 acres helicopter resulting in the lowest detrimental disturbance to soil within activity units on a per acre basis of the action alternatives. No temporary road construction would be needed. No subsoiling for mitigation to meet standard and guidelines would be needed. Risk of future soil heating related to approximately 62% of area exceeding 35 tons per acre of biomass.
Effects to Post-Fire Wildlife Habitat (Snags and Down Wood)					
Snag levels over time	This alternative provides an average of 36-48 snags/ac >= 10” across the project area in the short term 1 to 2 decades. By year 40 snag densities average 1-6 snags/acre of large >= 20”dbh. This alternative leaves 100% of the project area untreated.	This alternative provides an average of 18-30 snags/ac >= 10” across the project area post harvest. By year 40 snag densities average 1-6 snags/acre of large >= 20”dbh. This alternative leaves 60% of the project area untreated.	Response to this issue is similar as described for Alternative B, although the aerial harvest method would leave a greater number of snags up to 14” in diameter, which would remain standing for 1 to 2 decades. This alternative leaves 60% of the project area untreated.	This alternative provides an average of 36-48 snags/ac >= 10” across the project area post harvest. By year 40 snag densities average 1-6 snags/acre of large >= 20”dbh. This alternative leaves 95% of the project area untreated.	Response to this issue is similar as described for Alternative B, but this alternative has the greatest amount of aerial harvest systems leaving more snags 12 to 14” dbh that would remain standing for 1 to 2 decades. This alternative leaves 84% of the project area untreated.

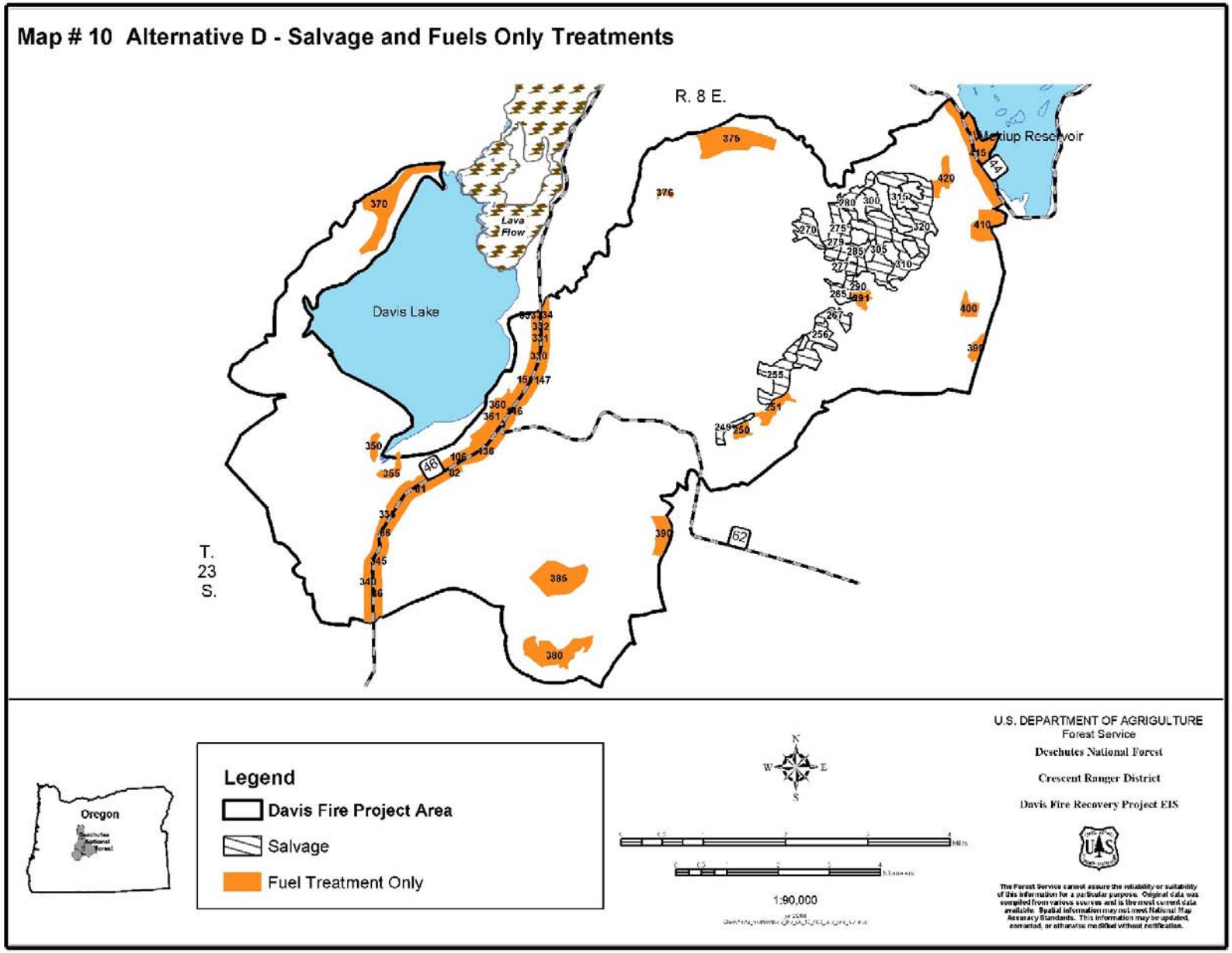
Years to snag recruitment (>= 20 inches dbh)	Snag recruitment in unburned and underburned areas is on going in all alternatives. In areas of 100% mortality snag recruitment is dependent on species planted or naturally regenerated. All untreated areas in all alternatives it is estimated 250-300 years to recruitment of snags >=20 inches dbh.				
Acres of dispersal habitat development	250-300 years	100-150 years on 12,750 acres of reforestation	Same as alternative B	100-150 years on 3,075 acres of reforestation	100-150 years on 7,200 acres of reforestation
Passive Recovery in Late Successional Reserve					
Regeneration by species	Natural regeneration would be mostly lodgepole pine, of lesser importance for long-term objectives for wildlife species that need large trees.	Planting of approximately 8,030 acres of conifer species would occur; important for long term objectives which include large tree-dependent species.	Planting of approximately 8,030 acres of conifer species would occur; important for long term objectives which include large tree-dependent species.	Planting of approximately 1,660 acres of conifer species would occur; important for long term objectives which include large tree-dependent species.	Planting of approximately 3,540 acres of conifer species would occur; important for long term objectives which include large tree-dependent species.
Forest succession and development of LOS	The majority of the stands would consist of lodgepole pine and tree species favorable for large tree development would not dominate the stand for at least 200 years.	Planted stands would consist (on average) 14" trees suitable for large tree development.	Planted stands would consist (on average) 14" trees suitable for large tree development.	Planted stands would consist (on average) 14" trees suitable for large tree development.	Planted stands would consist (on average) 14" trees suitable for large tree development.
Expected fire behavior, size, and intensity	Approximately 4,230 acres would have a sustainable fuel level, where the fire behavior, size, and intensity would not be excessive for soil heating.	Approximately 10,649 acres would have a sustainable fuel level, where the fire behavior, size, and intensity would not be excessive for soil heating.	Approximately 10,453 acres would have a sustainable fuel level, where the fire behavior, size, and intensity would not be excessive for soil heating.	Approximately 6,906 acres would have a sustainable fuel level, where the fire behavior, size, and intensity would not be excessive for soil heating.	Approximately 8,054 acres would have a sustainable fuel level, where the fire behavior, size, and intensity would not be excessive for soil heating.

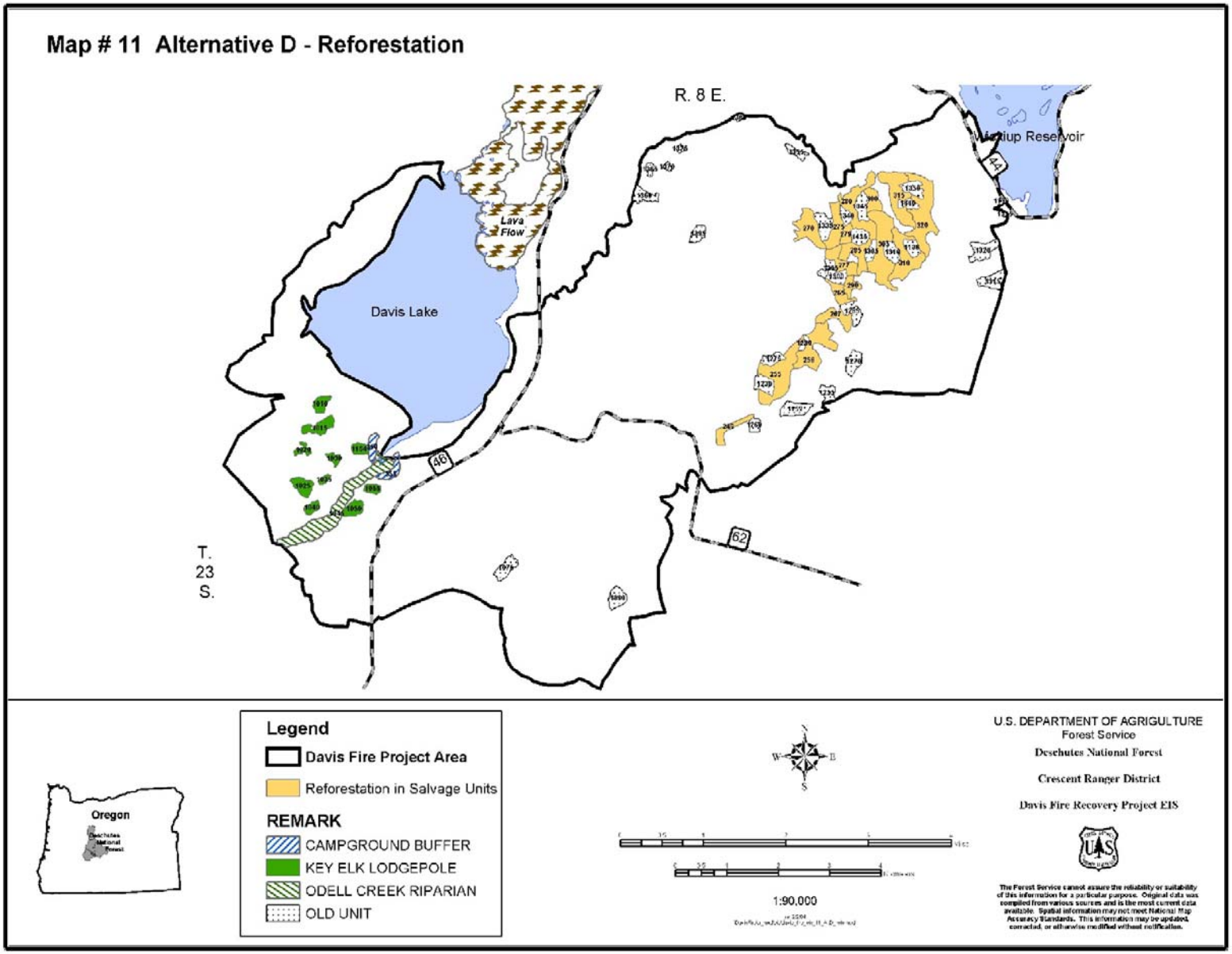

Map # 6 Alternative B - Salvage and Fuels Only Treatments
R. 8 E.
T. 23 S.
Davis Lake
Lava Flow
Wickiup Reservoir
Legend
Davis Fire Project Area
Salvage
Fuel Treatment Only
Oregon
Deschutes National Forest
1:90,959
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS
The Forest Service cannot assure the reliability or suitability of this information for a particular purpose. Original data was compiled from various sources and is the most current data available. Spatial information may not meet National Map Accuracy Standards. This information may be updated, corrected, or otherwise modified without notification.

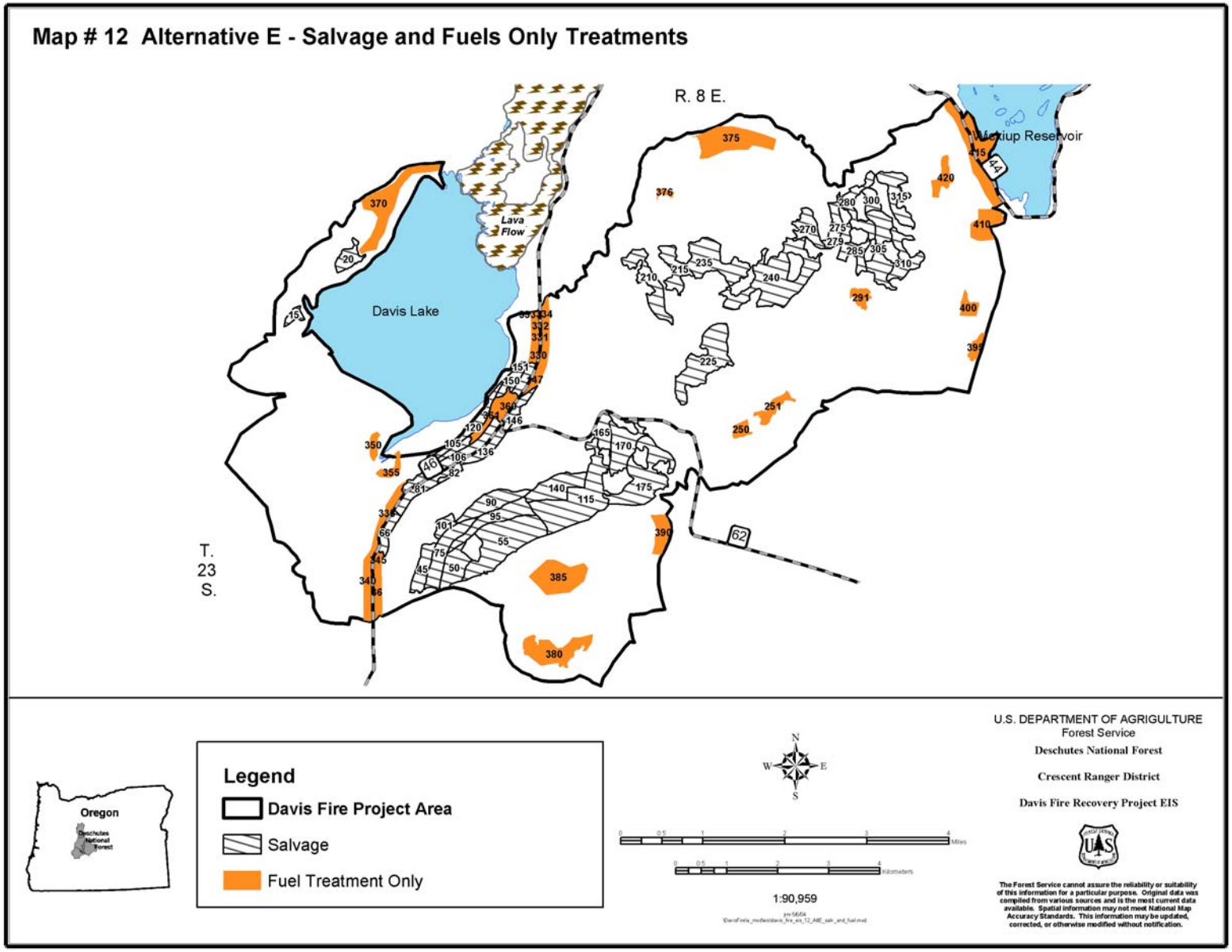

Map # 7 Alternative B - Reforestation
R. 8 E.
Wickiup Reservoir
Lava Flow
Davis Lake
T. 23 S.
46
62
44
Legend
Davis Fire Project Area
Reforestation in Salvage Units
REMARK
CAMPGROUND BUFFER
KEY ELK LODGEPOLE
ODELL CREEK RIPARIAN
OLD UNIT
Oregon
Deschutes National Forest
N
S
E
W
Miles
Kilometers
1:90,000
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS
The Forest Service cannot assure the reliability or suitability of this information for a particular purpose. Original data was compiled from various sources and is the most current data available. Spatial information may not meet National Map Accuracy Standards. This information may be updated, corrected, or otherwise modified without notification.

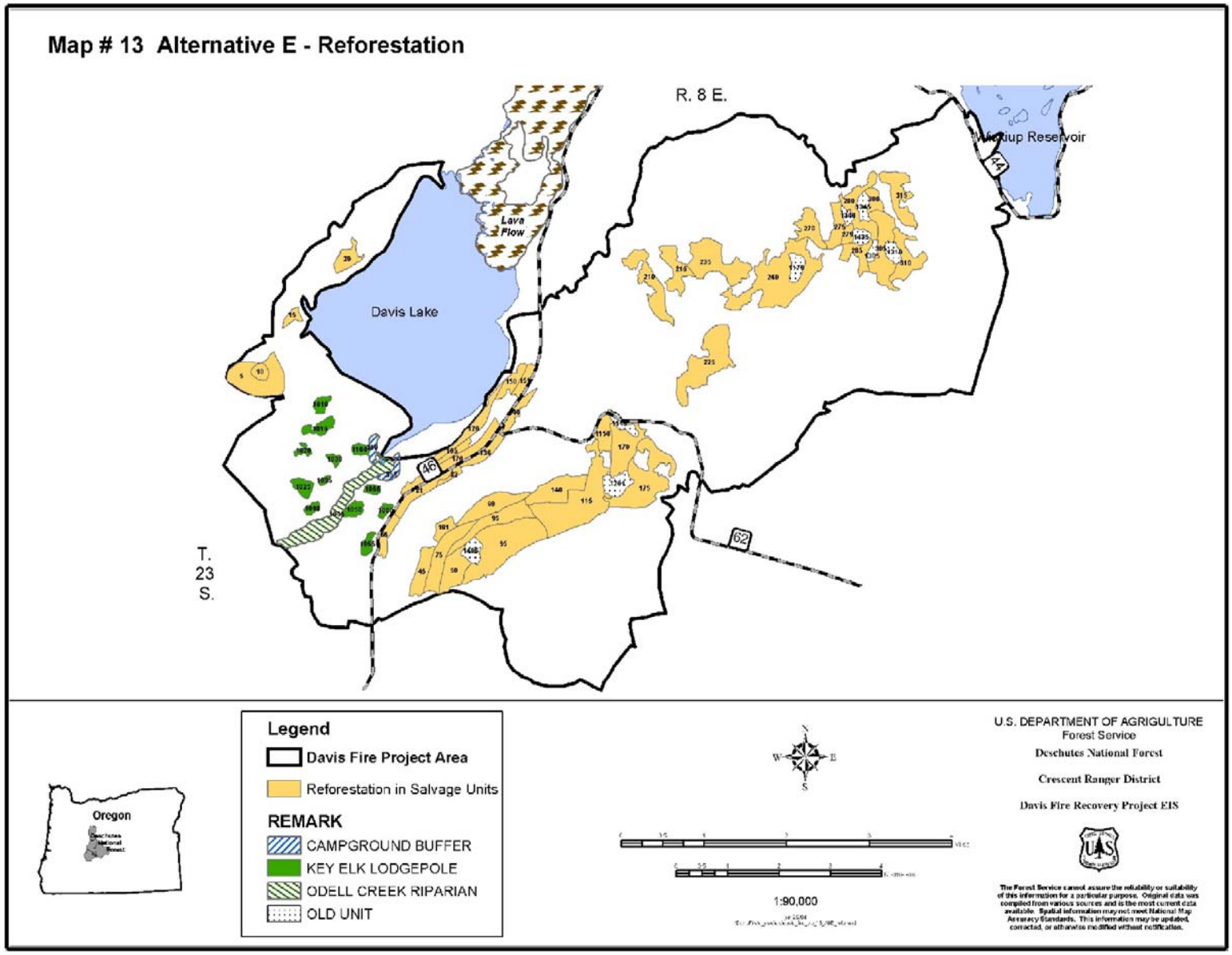

Map # 8 Alternative C - Salvage and Fuels Only Treatments
R. 8 E.
T. 23 S.
Davis Lake
Lava Flow
Wickiup Reservoir
Legend
Davis Fire Project Area
Salvage
Fuel Treatment Only
Oregon
1:90,000
U.S. DEPARTMENT OF AGRICULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS


Map # 9 Alternative C - Reforestation
R. 8 E.
T. 23 S.
Davis Lake
Lava Flow
Metolius Reservoir
46
62
44
Legend
Davis Fire Project Area
Reforestation in Salvage Units
REMARK
CAMPGROUND BUFFER
KEY ELK LODGEPOLE
ODELL CREEK RIPARIAN
OLD UNIT
Oregon
N
W
E
S
1:90,000
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS


Map # 10 Alternative D - Salvage and Fuels Only Treatments
R. 8 E.
T. 23 S.
Davis Lake
Lava Flow
Wickiup Reservoir
Legend
Davis Fire Project Area
Salvage
Fuel Treatment Only
Oregon
1:90,000
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS


Map # 11 Alternative D - Reforestation
R. 8 E.
Davis Lake
Lava Flow
T. 23 S.
46
62
Oregon
Legend
Davis Fire Project Area
Reforestation in Salvage Units
REMARK
CAMPGROUND BUFFER
KEY ELK LODGEPOLE
ODELL CREEK RIPARIAN
OLD UNIT
1:90,000
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS


Map # 12 Alternative E - Salvage and Fuels Only Treatments
R. 8 E.
T. 23 S.
Davis Lake
Lava Flow
Wickiup Reservoir
Legend
Davis Fire Project Area
Salvage
Fuel Treatment Only
Oregon
Deschutes National Forest
1:90,959
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS
The Forest Service cannot assure the reliability or suitability of this information for a particular purpose. Original data was compiled from various sources and is the most current data available. Spatial information may not meet National Map Accuracy Standards. This information may be updated, corrected, or otherwise modified without notification.


Map # 13 Alternative E - Reforestation
R. 8 E.
Wickiup Reservoir
Lava Flow
Davis Lake
T. 23 S.
Legend
Davis Fire Project Area
Reforestation in Salvage Units
REMARK
CAMPGROUND BUFFER
KEY ELK LODGEPOLE
ODELL CREEK RIPARIAN
OLD UNIT
Oregon
1:90,000
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS

Alternatives and Design Elements Considered But Not Fully Analyzed

During initial public scoping and alternative development, several suggested alternative concepts were considered. In addition to this effort, the Davis Fire Recovery Project IDT mailed a letter to interested people and asked for their comment on the range of alternatives on November 26, 2003. This section describes alternatives or design elements considered and explains why they were not given detailed study or how they are incorporated into alternatives that were studied in detail.

Restoration without Commercial Salvage

A non-commercial logging alternative emphasizing a passive management approach for restoration similar to those principles and recommendations found in the "Beschta Report" was suggested by some respondents. This was emphasized within the Late Successional Reserve and one respondent acknowledged that limited economic recovery could occur in lands "that are allocated to timber harvest."

Alternative D was fully analyzed early in the process to address this conceptual idea. Salvage within the Late Successional Reserve (which is almost sixty percent of the fire area) amounts to danger tree removal along 11 miles of public access. Alternative D proposes salvage on only 1,045 acres, all of which is outside of the LSR. Small diameter fuels treatments (only) in strategic areas for protection of high value resources, planting of conifer seedlings limited to those areas where salvage triggers the requirement to reforest, planting of lodgepole pine seedlings to jumpstart cover for big game in the Davis Lake Key Elk Area after two years of monitoring for natural regeneration success, and riparian planting along Odell Creek are designed into this "Passive Management" alternative.

The concept of a more limited intervention approach, with no salvage logging was considered but eliminated from detailed analysis for the following reasons:

The Purpose and Need for the project specifies recovery of late and old structured stands that provide habitat for dependent species, as well as a parallel emphasis to capture the value of trees in excess of ecological considerations within appropriate management areas. Because the commercial aspect of the proposed action was emphasized in the public comment, it is worth displaying the range of commercial activity included in the Alternatives. There are in excess of roughly 12,000 acres within the Davis Fire that could be characterized as burned commercial forest land that contains a commercial product. Using this basis, Alternatives B and C propose commercial activity on about 53%, Alternative D on 8.5%, Alternative E on 27%, and Alternative A on 0%. Also, another alternative considered but not fully analyzed included a proposal for commercial recovery within areas of the fire that burned with low and mixed intensity, in addition to the high intensity (see discussion next page).

Since the Beschta recommendations largely rely upon a passive approach to restoration, consideration of Alternative A provides an analysis of some of the components of this approach. Under implementation of Alternative A, restoration activities such as riparian planting and road closures could occur within the fire area with less rigorous analysis and therefore, would likely be pursued. The range of activities included in the fully developed action alternatives, combined with the consideration of the effects of the no-action alternative, offer a sufficient display of trade-offs and variation of effect to explore the issue embodied in the question of success of recovery through active management vs. recovery through a limited (or even non-) intervention approach.

The Davis Fire Restoration Project IDT response to the principles and recommendations found in the Beschta Report can be referenced throughout the DEIS Environmental Consequences section by resource, or a comprehensive response in Appendix C.

Roadside Salvage Logging on all Open Roads

For concerns over soil productivity, some respondents desired an alternative that completely protected soils using methods that did not use log skidding or mechanized equipment, except from the road prism and compacted areas.

The Davis Fire IDT considered this alternative but eliminated it from detailed study. To meet these objectives, trees would need to be hand felled and removed using full suspension of the log. The operational limit for equipment that could fully suspend logs from the roadside is about 35 feet. When applied to the entire transportation system, it would total approximately 500 acres.

In order to protect the road integrity, trees have to be felled away from the road. Because of the large size of some of the dead trees, they then cannot be reached for full suspension. This further reduces the efficacy. Within the LSR, the result would be similar to the passive management alternative (D).

This alternative was not fully analyzed because it did not meet the ecological nor the economic purpose and need specified in Chapter 1.

All alternatives being fully considered in detail are designed to meet the standards and guidelines for soil productivity (see Management Direction under the Soils section of Chapter 3).

Elimination of Post-Fire Logging in Areas Where Burnout Operations for Line Control Was Utilized

Some respondents believe that the Forest Service should not commercially enter stands that may have been deliberately burned to contain a wildfire during the suppression effort. The Davis Fire suppression operation backfired approximately 900 acres. The bulk of the backfiring operations occurred on Hamner and Davis Buttes to protect firefighter safety (i.e. direct vs. indirect fire line), and to reduce the amount of detrimental impact to steeper grades on the buttes (i.e. bulldozer lines would be more impactive than backfiring from existing roads).

Determination of which acres were backfired and which were not is an imprecise estimate as it is undeterminable exactly where the backfire and the approaching wildfire interface. Also, backfiring operations are often successful in stopping the fire, but sometimes not. Some areas within the fire perimeter were backfired, but subsequently lost to the wildfire, and these acres were not counted in the estimate given above. Given these variables, this alternative was considered but eliminated from detailed consideration because of the uncertainty of where and how much of these areas exist. If the appearance of unethical behavior is the concern, the incentive is greatly reduced in this circumstance because most of the backfiring occurred in areas that burned at low and mixed intensity which are not proposed for commercial salvage activities.

Sierra Club's Proposed Alternative

In response to scoping, the Sierra Club offered an alternative to the proposed action. In addition to preservation of the Davis Lake Special Interest Area for interpretive opportunities, the group proposed a "Conservation and Local Economy" alternative. In summary, this alternative redefines the purpose and need to propose:

- Protection of homes from wildfire while improving forest health;
- Sustainable forest health by allowing and facilitating natural recovery and succession;
- Providing opportunities for residents of Deschutes and Klamath Counties through standard Forest Service permitting procedures;
- Providing for the collection of scientific field data that greatly increases understanding of fire; and
- Providing jobs and income in respective counties through contractual mechanisms.

The features of this proposed alternative were given careful consideration and were not necessarily eliminated from detailed analysis, but were incorporated in the following manner:

Protection of homes from wildfire while improving forest health

The Sierra Club describes two "zones", one being within 40 meters of the home, and the other is everything outside of 40 meters. They believe the likelihood that a home might ignite as a result of a wildfire largely depends on the landscape in the zone within 40 meters (120 feet) of the home and cite publications that support their position. The Forest Service has reviewed these publications and does not disagree with the authors' conclusions. In general, ignition and fire spread is largely dependent upon local conditions.

Outside of the 40 meters, the Sierra Club believes natural succession should take its course. The Forest Service has incorporated different levels of passive management as a component within each alternative. "Natural" succession might be better characterized as passive management because the post fire condition, specifically levels of snags and down wood, may not be within historical parameters and therefore may not be in a condition many might consider natural (see the Forested Vegetation section and Appendix C for more discussion on the pre-fire landscape and conditions in relation to historic patterns).

Because of the proximity to the Wickiup Acres subdivision and the presence of live trees mixed throughout the stands, small diameter fuels reduction (only) along road 6220 is a design element incorporated into all action alternatives.

The Sierra Club also believes there should be a home site fuels reduction corps of locally hired workers and contractors and that the Forest Service should be more aggressive with a community education program that uses science that the Sierra Club believes to be relevant.

Through National Fire Plan grants, federal agencies have already been very involved with local homeowners and their representative agencies in fuels reduction projects that employ local workers. Also, the Crescent Ranger District has been collaborating with the residents of Wickiup Acres (a subdivision adjacent to the east end of the fire area) to reduce the fuel profile surrounding their homes – largely within 40 meters. The State of Oregon has responsibility for individual actions homeowners take to reduce their threat on private property; however Forest Service staff promote fire prevention and defensible space at various cooperative ventures with local partner agencies.

Sustainable forest health by allowing and facilitating natural recovery and succession

The Sierra Club believes wildfire is a major force of nature and is a natural process within the planning area. Also, they believe that human intervention is not necessary, except to remove/rehabilitate roads and allow lightning-caused fire to play its ecological role. Beschta and others were cited in support of this position. The Davis Fire Restoration Project IDT has reviewed these publications and a response to the principles and recommendations to the Beschta Report can be referenced in Appendix C. In summary, there is a need to increase the suppression effectiveness of future subsequent wildfires in proximity to the Wickiup Acres subdivision and the city of La Pine, Oregon.

The Davis Fire Recovery Project IDT considered ways to move the landscape to the desired condition and developed an issue that addresses the concern for less active management. To reduce the biomass from non-commercial means would forego opportunities to offset costs inherent with reforestation and fuels reduction. Subsequently, Alternative D reduces the acres of active management and allows "natural processes" to take a larger role – particularly within the Late Successional Reserve. To allow lightening-caused fires to play their ecological role within the area is outside the scope of this analysis without a prescribed natural fire plan. Use of prescribed natural fire would need more extensive public involvement, especially by those that live adjacent to the area, before a proposal such as this could be carried forward. However, the DEIS analyzes the return of fire to its historic role particularly within ponderosa pine stands to varying degrees. The use of prescribed fire with the objective of reintroducing low intensity fire could be delayed for decades where no salvage and/or fuels treatment occur first (see Forested Vegetation section).

Providing opportunities for residents of Deschutes and Klamath Counties through standard Forest Service permitting procedures

The Sierra Club believes there should be opportunities for local residents to access traditional forest products in the project area. The Forest Service agrees and some of the work may be offered in the form of "goods for

services", or stewardship type contracts. None of the alternatives specify how the allocation of traditional forest products is divided among local residents or other interested citizens. Permits to obtain special forest products such as post and poles, fungi, or firewood would be considered, if the environmental effects of such actions are consistent with the decision for this EIS. Each would be considered on a case by case basis.

Provide for the collection of scientific field data that greatly increases understanding of fire

Several entities such as the Soil and Water Conservation Service, Pacific Northwest Experimental Station, and local scientists, have approached the Crescent Ranger District to design proposals to research the fire effects in the Davis and other fires in Central Oregon. Topics range from wood utilization and deterioration, effects of fire on soil properties, and efficacy of small wood removal on fire hazard. Many of these proposals are in the design phase and are expected to be submitted for funding. None of the alternatives in this document preclude these opportunities.

Provide jobs and income in respective counties through contractual mechanisms

The Sierra Club believes an alternative should provide jobs and income through contractual mechanisms for restoration-related activities which do not include salvage harvest. It is expected that some of the restoration work will provide opportunities for local employment such as revegetation, weed control, and application of prescribed fire (when prescriptive conditions are feasible).

Preservation of Davis Lake as a Special interest Area

The Davis Lake Special Interest Area (SIA) includes Davis Lake and its shores. Page 1-5 describes the Forest Plan goals for this area. Under Alternative D, no commercial salvage activity within the special interest area is proposed. However, where the SIA overlaps a Key Elk Area, planting of conifers is proposed for big game cover after a two year monitoring period for natural regeneration success. Also, small diameter tree thinning and non-commercial fuels reduction would occur as part of an overall protection strategy for adjacent resources that have a high value. Most of the Special Interest Area would remain in a condition that offers interpretation of "natural" recovery processes. This alternative was eliminated from detailed study because other action alternatives are similar in offering such opportunities, include some salvage harvest, and are consistent with the Deschutes National Forest Plan for Special Management Areas (see page 3-387).

Creating a Fuelbreak Surrounding the Entire Area to Isolate the Hazard

The IDT considered modifying the entire perimeter of the fire area by creating fuelbreaks and allowing ecological processes inside the fire perimeter to play their "natural" role. Fuel breaks and their efficacy are highly dependent upon a variety of conditions such as fuelbeds, weather, topography, drought conditions and time of day. On the Deschutes National Forest, fuelbreaks have been shown to be successful in some circumstances, particularly where stands and fuelbeds have been modified on a landscape scale. The purpose and need for this project is to facilitate the return of the area into a sustainable condition where fire can be carefully applied back into the fire-adapted dry plant association groups. Although the Davis Fire was determined to be human-caused, the majority of the fire starts in the area are caused by lightening (reference Fire and Fuels section in Chapter 3). Given the random efficacy of fuelbreaks without landscape scale fuels reduction, limited control over ignitions, and the adjacent resources at risk, this alternative was eliminated from detailed consideration. In addition, a dual purpose to capture some form of economic value to offset restoration activities would not be satisfied.

Planting Conifers without Biomass Reduction Activities, Particularly Larger Logs

Some people who commented believe the Forest Service should reforest without commercial removal of biomass.

The IDT has displayed the commercial versus non-commercial (passive management) alternatives in this section. The Forest Service considers protection of investments such as conifer reforestation to be prudent. Also, reforestation costs can be offset by commercial removal.

Recent science from the Rocky Mountain Research Station (Brown et al, 2003) discusses the elements of large down woody material that can contribute to potential fire behavior. On page 4, the science states "Large woody fuels have little influence on spread and initiating surface fire in current potential fire behavior models; however, they can contribute to the development of large fires and high fire severity. Fire persistence, resistance-to-control, and burnout time (which affects soil heating) are significantly influenced by loading, size, and decay state of large woody fuel." In the Davis Fire, the analysis has determined fuel loadings to exceed those levels considered to be sustainable (Agee 1996; Brown et al 2003) for dry plant association groups found within the area. Comprised of large and small logs, the fuel profile is estimated to range up to 80 tons per acre if no active management is pursued. The fire and fuels management report has also determined that the smaller or "fine" fuels, if not present, would be readily available on the forest floor through natural processes such as from breakage from natural snag fall and shrub growth in a relatively short period of time. Given the expected potential for fire behavior and the resistance to control, it is reasonable to assume the risk of losing an investment such as reforestation is much greater if no biomass reduction (including large logs) were performed. In addition, application of prescribed fire to mimic its role in these fire-adapted stands would be precluded if protection of young live trees is a desired outcome. This alternative was considered and eliminated from detailed consideration.

Moving Burned Bald Eagle Management Areas (BEMAs) to Adjacent Live Stands

The Davis Fire IDT considered relocating portions of Bald Eagle Management Areas that were affected by the Davis Fire (Wickiup and Davis Lake BEMAs) to adjacent suitable habitat. This alternative was considered and eliminated from detailed study because most of the highest quality habitat in the area is already allocated to Bald Eagle Management. There is a relatively small amount of adjoining areas that may be considered suitable bald eagle habitat, but these areas are generally allocated to intensive recreation (Administratively Withdrawn), an allocation that may or may not be compatible with objectives for suitable habitat management.

Chapter 3

Affected Environment and Environmental Consequences

CHAPTER 3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

Introduction

This chapter summarizes the physical, biological, social, and economic environments of the project area and the anticipated effects of implementing each alternative on that environment.

The "Affected Environment" refers to the existing biological, physical, and social conditions of an area that are subject to change, directly, indirectly, or cumulatively as a result of a proposed human action. Information on the affected environment is found in each resource section under "Existing Condition." The effects may be direct, indirect, or cumulative.

Chapter 3 Changes Between Draft EIS and Final EIS

In addition to minor editing of all sections, the following changes to the FEIS have been made:

Portions of the soil section has been updated for clarifications.

Adjustments have been made to reflect direction of the 2004 Survey and Manage Record of Decision to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines.

Clarification and wording changes in the mitigation, northern bald eagle and northern spotted owl sections were a result of ongoing consultation with the US Fish and Wildlife Service and new information resulting from 2004 field surveys.

The Fisheries section has been updated to include the results of recent surveys and additional information has been added to explain the work and accomplishments of the Odell Lake Bull Trout Recovery Team. More information has been added describing the status of the redband trout and mountain whitefish in Odell Creek. Current condition information has been added for Crescent Creek, though it falls outside of the project area. Cumulative effects analysis has been updated to include recent and future projects.

Soils

Key Issue: Effects to Soils

Cumulative impacts from proposed ground-based harvest and fuels treatment activities may lower soil productivity below desired levels.

Maintenance of soil productivity is an important objective for forest management. The loss of organic surface cover following the wildfire and suppression activities may have elevated the sensitivity of the soil resource to additional physical impacts such as displacement or compaction. In addition, past management activities have incurred various levels of impacts, such as displacement and compaction that could cause proposed activities to cumulatively create detrimental disturbance in some areas at levels capable of affecting soil productivity.

Attributes and Measures: Area and extent of detrimental disturbance and cumulative effects from alternatives, past actions, and reasonably foreseeable actions on soil productivity.

Introduction

Landscape Setting

The Davis Fire area covers approximately 21,112 acres on the flanks of Davis Mountain and Hamner Butte and the basin area to the south of Davis Lake. The area includes portions of the Odell Creek, Davis Lake, Davis Creek, Hamner Butte, Middle and Lower Crescent Creek, and Wickiup subwatersheds. Landtype classification in the Deschutes Soil Resource Inventory (SRI) at the landscape level describes the Davis and Hamner Buttes as part of the Stratovolcanoes Physiographic Area, a group of stratovolcanoes nearly unmodified by glaciers or other erosional agents. General sizes are approximately 2,000 feet high, measure 3 to 5 miles in diameter at their bases and exhibit low, nearly straight-line profiles. The flanks of Davis Mountain and Hamner Butte overlap with the fire area (Larsen 1976).

Topography of this physiographic area varies from gentle to moderately steep. The 10-foot Digital Elevation Model calculates a total of 1,900 acres, or approximately 9% of the fire, are with slopes exceeding 25% and 752 acres (3.5%) with slopes exceeding 30%. Elevational differences range from just over 7,000 feet at the summit of Hamner Butte to 4,400 feet along the shores of Davis Lake. Aspects within the fire area are generally northerly on Hamner Butte and southerly, southwesterly and easterly on Davis Mountain.

Primary geologic features comprising Davis Mountain and Hamner Butte include a variety of lava flows, scoria, breccia, ash and dike complexes. These two landscape features are considered basaltic-andesitic stratovolcanoes. Although the surface features of the project area have not been glaciated, the Davis Lake basin is underlain by glacial outwash associated with the glaciated Odell Lake valley to the west. A deep mantle of airfall volcanic ash and pumice from Mt. Mazama comprises the surface portion of the regolith layer throughout the project area.

Climate

Precipitation patterns within the project area are primarily influenced by Pacific Ocean fronts driving inland during the wet season months of November through March. Annual precipitation amounts range from between 30 inches in the basin area to over 50 inches at the upper elevations of the Davis Mountain. Davis Mountain and Hamner Butte are located just to the east of the Cascade crest along an area of relatively low topography created by Maiden Peak and The Twins. These features provide a slightly lower rain shadow effect for areas immediately to their east than do larger Cascade features like the Three Sisters to the north and Diamond Peak to the south.

Late fall and winter precipitation falling above 4,000 feet generally accumulates as snowpack that melts off during the spring and early summer months. Much of this snowmelt appears to contribute to subsurface recharge within the subwatersheds, with very little surface drainage occurring off of either Davis Mountain or Hamner Butte. Neither of these landforms has intermittent or perennial streams draining off of their extensive surface area of slopes. Odell and Ranger Creeks are the only perennial stream channels and Moore Creek is the only intermittent stream channel within the fire area, all of which feed into Davis Lake through the gentle Davis Lake basin. Odell Creek emanates from Odell Lake outside of the fire boundary with a number of spring-fed tributaries contributing steady flows.

Ranger Creek begins from a spring located within the fire boundary and has a very stable annual flow level along very low gradient basin reach.

Precipitation can also fall as mid-summer thunderstorm and/or mid-winter rain on snow events capable of generating significant rainfall totals of high intensity over relatively short periods of time. Summer weather cells emanating from the Umpqua Basin to the southwest or the Klamath Basin to the south reach the area by tracking along the crest of the Cascades and following the Deschutes Basin to the north (Rapp, personal communication). These cells are generally hit or miss in regards to area and amount of rainfall from one system to the next.

Mid-winter rain on snow events are generally the result of warm "pine apple express" weather systems directed from the central Pacific by a sub-tropical jet stream that can produce heavy rainfall for extended periods of time. Although thunderstorm and rain on snow events contribute a small percentage of total annual rainfall, their high intensity rainfalls can create overland flows capable of eroding surface material and moving sediment along road conduits.

Temperature and precipitation cycles for the area are generally warm and dry for the summer months and cold and wet during the winter months. Average maximum temperature is 80º F in August and average minimum temperature is 18.9º F in January at the 4,360 foot elevation for Wickiup Dam, OR, NWS COOP station located approximately 2 miles to the northeast of the project area. Period of record is 1971 to 2000 (Western Regional Climate Center, USDA Forest Service 1996).

Vegetation

Vegetative communities within the project area are classified as plant association groups (PAGs) and range from Mixed Conifer Wet at the upper elevations, Mixed Conifer Dry at the mid-elevations and Lodgepole Pine in the Davis Lake basin (Volland 1988). (Refer to PAG Map #15, and Forested Vegetation section). The site potentials of each PAG influence cover provided by herbaceous perennials, shrubs and overstory crowns, which in turn provide organic input to the soil surface. Site potentials are generally high for the majority of the Mixed Conifer PAGs within the project area, with lower potentials in the upper elevation Mixed Conifer Wet PAGs located on Hamner Butte and Davis Mountain, and the Lodgepole PAG located within the Davis Lake basin. Biomass production is directly related to the site potentials of these plant associations and contributes to various aspects of soil development and fertility. Live and dead organic surface cover influences erosion mechanisms associated with the detachability of exposed surface mineral soil during rainfall events capable of creating overland flows.

Soils

Soils within the area have developed under the influence of local geologic parent materials, topography, annual precipitation, and associated vegetative communities. The Deschutes Soil Resource Inventory (SRI) (Larsen 1976), is the only mapped coverage of soils within the project area. This survey was conducted as a broad scale mapping of soil types across the Deschutes National Forest and includes basic soil information and interpretations for the soils included in the survey.

Soil types within the project area located on the slopes of the larger buttes are primarily comprised of a deep mantle of ash and pumice fall from Mt. Mazama over an older paleosol derived of airfall ash and basaltic residuum (weathered in place). A deep mantle of ash and pumice fall also overlies an older soil located above glacial outwash within the Davis Lake basin.

The rhyolitic Mazama ash and pumice fall is relatively coarse textured and undeveloped due to a young age of 7,600 years. Surface and subsurface textures range from coarse sand to small gravel sized material. Surface mineral A horizons are generally less than 2 inches thick, with a shallow A/C horizon of less than 10 inches in thickness. The pH of representative surface horizons ranges from 6 to 6.8. C horizon material varies from 20 to 40 inches thick before the slightly more developed buried soil is reached. Higher bulk densities and coarse fragment contents are the most distinguished features of the residual buried soils. Soil moisture regimes are Xeric in the basin and the eastern edges of the area and Ustic in the higher elevation sections. Soil temperature regimes range from frigid to cryic.

Sensitive soils

Soil Resource Inventory (SRI) map unit descriptions are used to identify sensitive soils under criteria listed in the Deschutes National Forest Land and Resource Management Plan (LRMP), Appendix 14, Objective 5. Areas with sensitive soils (see map #14, page 3-64) have management limitations that need to be addressed during the planning of vegetation management activities. Soils identified as sensitive within the Davis Recovery Project Area include the following:

- Mapping units with a majority of the area having slopes over 30% with high displacement hazard ratings (SRI units 68, 69, 9Z and 84) 1,534 acres (7%)
- Poorly to somewhat poorly drained soils and/or a seasonal water table at or near the soil surface (SRI unit 44, and complexes WE, including units 43, 44, and WF, including units 5, 43, and 44 (332 acres, 1.5%)
- Mapping units with high-moderate surface erosion hazard ratings (SRI units 84 and 9Z) 1,356 acres (6.4%)
- Mapping units with low inherent productivity (SRI unit 84 and 85) 1,915 acres (9%)
- Frost pockets affecting regeneration survival (SRI units 96) 2,092 acres (10%)

Sensitive soils identified within activity units proposed under Action Alternatives of the EIS are primarily those with slopes having high susceptibility to displacement (SRI units 68, 69 and 9Z) and frost pocket areas (SRI unit 96). The removal of organic surface cover as a result of the fire has elevated the risk of soil displacement from machine and yarding activities throughout the fire area. Other map units with slopes approaching 30% (SRI units 98), or portions exceeding 30% (SRI units 9Z and the 9Z component of complex PN) are also susceptible to displacement of surface mineral soil from machine traffic and yarding operations.

Slopes within the project area exceeding 30% as defined by the 10 foot Digital Elevation Model total approximately 752 acres. Areas of slope exceeding 25% within activity units proposed for ground-based operations are prioritized for inclusion in the 15% wildlife retention areas and total 908 acres in Alternative E, 50 acres in Alternative D. Under Alternative E, 665 acres over 25% would be avoided.

All bottomland areas with seasonal water tables (SRI units WE and WF) are found along stream course and valley bottoms and are included within Riparian Reserves outside of proposed salvage unit boundaries. Map units having very low productivity (SRI units 84 and 85) are located on the upper slopes of Hamner Butte and Davis Mountain. Portions of two proposed salvage activity units are found at the lower elevation of map unit 84 on the south side of Hamner Butte and one fuels treatment unit is located on this map unit.

Suitability

The Deschutes Forest Plan suitable lands database identifies areas considered to be suited for timber production using criteria affecting reforestation (FSH 2409.13). This layer was developed to designate a planning level timber base area for the Forest Plan and is broad scale in nature. Project level planning requires that lands proposed for harvest have their suitability verified based on the criteria outlined within the handbook (FSH 1909.12). Lands that do not meet these criteria are considered unsuitable or partially suitable for timber harvest due to regeneration difficulties or the potential for irreversible damage from management activities.

The suitability layer identifies three areas within the Davis Fire Recovery Project area considered to be unsuited or partially suited for commercial timber production. No salvage units are proposed within the unsuited areas located on top of Davis Mountain and Hamner Butte. A portion of proposed salvage activity unit 25 originally included soil map unit 70, which is considered partially suited for timber production due to frost pocket problems affecting planted stock following clearing. The portions of unit 25 that included this soil map unit were moved to the adjacent fuels treatment activity unit 380 during the planning process. The unsuited areas on top of Davis Mountain and Hamner Butte do not have proposed salvage units within them. One unit on Hamner Butte, where only small diameter trees would be thinned, does lie within this area. The partially suited area is located on the western edge of the project area and overlays a portion of one commercial salvage unit. This area is classified as partially suited due to frost problems after clearing on the SRI map unit 70 component of the SRI complex LL. Partial suitability is defined as having an unsuited condition on at least 30% of the mapping unit area.

Management Direction

The Deschutes National Forest LRMP includes Standard and Guidelines for management of the soil resource intended to maintain or enhance long-term soil productivity (LRMP 4-70, SL-1, SL-3 and SL-4). Regional Standards and

Guidelines (FSM 2500, R-6 supplement 2500-98-1) describe conditions detrimental to soil productivity and outlines Soil Quality Standards to limit the extent of these conditions to less than 20% of an activity area. Detrimental soil conditions are described in the Soil Quality Standards as follows:

- Detrimental soil compaction in volcanic ash/pumice soils is an increase in soil bulk density of 20 percent or greater over the undisturbed level.
- Detrimental puddling occurs when the depth of ruts or imprints is six inches or greater.
- Detrimental displacement is the removal of more than 50 percent of the A horizon from an area greater than 100 square feet and at least 5 feet in width.
- Detrimental burn damage requires significant color change of the mineral soil surface to an oxidized reddish color, with the next one-half inch below blackened from organic matter charring as a result of heat conducted from the fire.
- Detrimental erosion requires visual evidence of surface loss over areas greater than 100 square feet, rills or gullies, and/or water quality degradation from sediment or nutrient enrichment.

The Forest Service Region 6 Supplement also includes policy direction for designing and implementing management practices which maintain or improve soil and water quality. An emphasis is placed on protection over restoration. Specifically, under 2520.3 – Policy, the narrative reads:

"When initiating new activities:

1. Design new activities that do not exceed detrimental soil conditions on more than 20 percent of an activity area. (This includes the permanent transportation system).
2. In areas where less than 20 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effect of the current activity following project implementation and restoration must not exceed 20 percent.
3. In areas where more than 20 percent detrimental soil conditions exist from prior activities, the cumulative detrimental effects from project implementation and restoration must, at a minimum, not exceed the conditions prior to the planned activity and should move toward a net improvement in soil quality."

Deschutes National Forest direction for interpreting and implementing this policy is outlined in the document "Final Forest Plan Interpretation: Standards and Guidelines – Forest-wide SL-3 and SL-4" formulated and finalized by the Forest Interdisciplinary Team on March 15, 1996 (Herrick 1996).

The Davis Fire Recovery project area is comprised of Deschutes LRMP allocations M8, General Forest. The majority of the project area lies within allocations defined by the Northwest Forest Plan, including Matrix, and Late-Successional Reserve. Standards and Guidelines for the soil resource within these Northwest Forest Plan allocations are the same as those applicable for management activities in the LRMP General Forest (M8) allocation and are described previously in this report under Management Direction.

Desired Future Condition

The primary goal for managing the soil resource is the maintenance or enhancement of long-term site productivity. Region 6 Soil Quality Standards (FSM 2500, R-6 supplement 2500-98-1) define detrimental soil conditions that can reduce long-term site productivity. Desired future conditions for the soil resource include limited detrimental soil impacts across the landscape in order to maintain normal site functions associated with soil, plant and water interactions, and the maintenance of biomass on the soil surface after management activities to provide nutrient input and biotic habitat for the system. Desired conditions also entail the promotion of vegetative and organic litter cover on the soil surface to reduce erosion losses from overland flow events that might impair the productivity of the soil resource.

Existing Condition

Pre-fire Management Activities

Previous Analysis

The Odell Watershed Analysis (USFS 1999) included the Odell Lake, Odell Creek, Davis Lake, and Moore Creek subwatersheds within its analysis boundary. The Seven Buttes and Seven Buttes Return Environmental Assessments are the most recent record of analysis within any portion of the Davis project area and include activity units within the Odell Creek, Davis Lake, Hamner Butte and Wickiup subwatersheds.

Resource trend tables included in the Odell Watershed Analysis identified an increasing trend for soil compaction from past activities within the subwatersheds. The analysis also identifies a high susceptibility of the soils present to the loss of nutrients due to the ease of surface material displacement from machine traffic. Elevated sensitivity ratings were identified for soils with higher elevation conditions that limit the length of seasonal biological activity within the soil profile; finer textured surface soils; profiles with lower coarse fragments to resist impacts; and areas where the presence of a restrictive layer of compacted glacial till was within the rooting zone of trees. These soils covered 47% of the watershed analysis area, primarily concentrated west of Davis Lake. Specific areas identified as highly sensitive within the Davis fire recovery project area include the upper elevation slopes of Hamner Butte, the slopes of Ranger Butte and the stream course and floodplains of Ranger and Odell Creeks.

The Odell analysis also identified the inherent and existing soil quality of soils within the area. The majority of soils located within the proposed activity units of the Davis Fire Recovery Project have a high inherent productivity based on site index measurements of growth rates, medium historic soil quality and low to moderate levels of existing detrimental impacts. Additional harvest treatments under the Seven Buttes and Seven Buttes Return Environmental Assessments have altered existing soil quality within a relatively small portion of the Davis Lake, Hamner Butte and Wickiup subwatersheds.

Analysis Area and Context

Seven subwatersheds have portions of their acreage within the fire recovery project area. Approximately 36% of the Davis Lake subwatershed lies within the fire perimeter and contains the spring fed Ranger Creek. Approximately 23% of the Odell Ck subwatershed lies within the fire perimeter and contains the approximately seven mile perennial reach of Odell Creek between Odell Lake and Davis Lake. Wickiup and Hamner Butte subwatersheds have approximately 17% and 27%, respectively, of their total acreage within the fire perimeter, none of which contribute to perennial or intermittent stream reaches within the subwatershed or even to ephemeral stream drainages that feed such reaches. The Davis Creek, Middle Crescent, and Lower Crescent subwatersheds have approximately 7%, 0.7%, and 1.5% of their total acreage within the fire perimeter, none of which contributes to perennial or intermittent streams (see table 3.3 page 3-73). For these reasons, harvest activities and their associated detrimental impacts were only analyzed in total for the Odell and Davis Lake subwatersheds and summarized within the fire perimeter for the remaining subwatersheds.

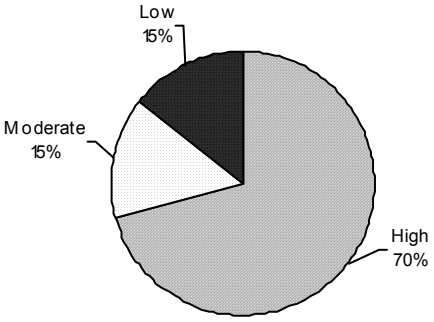


Figure 3.1 Inherent Soil Productivity Across Project Area

Inherent Soil Productivity

The productivity of the forestland soil resource can be measured as the Cubic Foot Site Class (Mean Annual Increment in cubic feet/year) or the Site Index (Mean 100 year height) of primary tree species located on sites considered to be undisturbed or in low disturbance conditions. Since cubic foot site class and site index numbers are means averaging multiple years of growth they cannot be used to reflect immediate changes in productivity on site but are valuable as a baseline soil productivity indicator reflective of potential production under low detrimental disturbance conditions. These indices are also a reflection of the resilience of a soil type to maintain productivity following disturbance from management activities or fire.

Volume and height indices for each soil type are included in the Deschutes SRI. A qualified descriptor of productivity has been assigned to the cubic foot site class for each soil type ranging from Very Low (site class 7) to High (Site class 4). Site classes 1, 2 or 3 have the highest cubic foot growth rates but are not found on the Deschutes National Forest. Soil types having site class 7, with Mean Annual Increment of less than 20 cubic feet/year, are considered unsuited for Forest Production and are included in the Deschutes LRMP Suitability Layer as unsuited.

Soil productivity classes for the SRI units within the Davis Fire Recovery project area total approximately 14,502 acres of high (70%), 3,009 acres of moderate (15%), and 2,986 acres of low (15%) productivity (Soil GIS map).

Approximately 3% of the area within the fire perimeter is surface water of Davis Lake or the perennial stream courses of Odell and Ranger Creeks. In general, soils within the Davis project area have a high inherent productivity due to their depth, moisture holding capacity, and lack of coarse fragments within the rooting zone. Soil productivity is also enhanced by the relatively high annual precipitation throughout the area.

Detrimental Soil Conditions

Impacts to the soil resource are considered to be detrimental if they exceed Standards and Guidelines defined in a Regional Supplement to the Forest Service Manual direction for the soil resource (FSM 2500, R6 Supplement 2500-98-1). Soil quality standards under this direction apply to conditions such as compaction, displacement, puddling, burn damage and surface erosion. Soil quality guidelines included in this supplement address organic matter and moisture regimes related to the soil types on site. Impacts incurred from past timber harvest activities are primarily a result of ground-based machine harvest, yarding and fuels treatment operations. These impacts are most often expressed as compaction in areas of multiple machine passes or displacement in areas where machines have turned abruptly on loose mineral soil and/or sideslopes.

Past harvest, yarding and fuels treatment systems can incur detrimental compaction over 15 to 30% of a unit area depending on topography, harvest prescriptions and volume removed per acre (Deschutes Monitoring Report 1998). Cumulative detrimental impacts as a result of multiple entries and uncoordinated skid trail systems can raise this level to 40% or higher. Monitoring has shown that bulk density increases of greater than 20% in soil types similar to those present in the Davis project occur after multiple passes of harvest and skidding machinery (Deschutes Monitoring Report 1997). Although some natural recovery from compaction can occur through freeze thaw mechanisms, the soil resource in areas covered by skid trails and landings can remain detrimentally compacted for many years following operations. In general, the surface area dedicated to skid trails and landings comprises the large majority of compaction within an activity unit. A portion of the soil resource between skid trails can be detrimentally compacted in areas of multiple machine passes from the harvest, yarding and/or fuels treatment operations.

Harvest History

The soil resource within the project area has been impacted primarily from past management activities associated with timber harvest and road construction. Records of these activities are tracked back into the 1960s and are compiled in a GIS layer. Harvest prescriptions from these activities and aerial photo interpretation from various flight line dates are helpful in augmenting field reconnaissance when assessing cumulative impacts to the soil resource from past management activities. Table 3.1 summarizes past harvest activity within the primary subwatersheds of the project area from documented records included in the Crescent harvest GIS layer.

Table 3.1 Past Harvest Activity and Existing Detrimental Conditions within Subwatersheds Containing Perennial Streams

Subwatershed (Acres)	Acres w/past Harvest Activity (% of Subwatershed)	Acres of Roads (% of Subwatershed)	% Subwatershed Detrimental (acres)*
Odell Ck (13,830)	3,559 (26%)	268 (1.9%)	7% (980)
Davis Lake (22,505)	5,498 (24%)	345 (1.5%)	6.4% (1,445)

* Detrimental acres were calculated as an average of 20% of past activity unit acreage plus existing road acreage within each subwatershed. Detrimental acreage within past activity units ranges from 10 to 30% depending on harvest prescriptions and number of entries.

Past harvest activity within the Odell Creek and Davis Lake subwatersheds covers approximately 26% and 24%, respectively, of the total subwatershed acreage. Harvest prescriptions throughout the area range from 1970 through

1990 era clearcut or shelterwood/final removal prescriptions to highly variable selection cut prescriptions that occurred as early as the 1960s. Activity prescriptions occurring in the last decade are primarily commercial thins at relatively low volume levels in order to maintain Nesting Roosting and Foraging habitat for the northern spotted owl. Detrimental soil disturbance levels measured in past activity areas on the District and Forest generally range from 10 to 40%, depending on harvest prescriptions, volume removed, and the number of entries within a given unit area (Deschutes Soil Monitoring Reports, 1993-2001).

Field Measurements and Observations

Field analysis of existing soil conditions within past harvest units within and outside of activity areas proposed under this project was conducted during the fall field season following the fire (Sussmann 2003). Observations include measurements of detrimental compaction and displacement, presence/absence of litter and duff following the fire and the extent of post-fire needle cast. Field measurements included the probing of machine trails to measure resistance to penetration in order to gage the amount of surface area detrimentally compacted. The information was collected for a subset of units proposed as possible activity units having a variety of past management activity prescriptions.

Field observations of past harvest prescriptions were made for clearcuts, selection cuts, and commercial thinning that utilized ground-based systems and show that impacts from these activities are primarily in the form of subsurface soil compaction beneath skid trails and landings utilized by ground-based systems to harvest and yard material. Displacement of surface organics and mineral A horizon material also occurred to varying degrees on these areas. Detrimental acreage within past activity units was measured to be upwards of 30% within clearcut prescription unit areas to as low as 5 to 10% within single entry, commercial thinning prescriptions and some selection cut areas.

Selection cut prescription areas had relatively haphazard machine traffic to yard harvested trees with visible trails generally covering 5 to 10% of units. Since trees harvested under these operations were primarily large enough to require hand felling, many of the existing trails have a low number of machine passes that occurred during the yarding of a single tree or a few logs from the same tree. Most of these trails were observed to have varying levels of detrimental compaction, while contiguous areas of displaced surface organic and mineral soil generally covered less than 50 square feet. As a result, many of the observed machine trails currently present are not considered to be detrimentally compacted but do have portions of their area displaced of surface organics and organic mineral A horizons.

Existing Detrimental Disturbance within Proposed Activity Areas

In general, the amount of area in detrimental condition within proposed activity units from past harvest systems is relatively low and currently meets the Regional 20% Standard for the allowable extent of detrimental conditions. Table 3.2 is a summary of surface area in skid trails and landings within proposed activity units for the Action Alternatives.

Table 3.2 Existing Detrimental Disturbance within Proposed Activity Units

% of Activity Area* in Skid Trails and Landings	0 to 5%	5 to 15%	15 to 20%	>20%
Alt B units** (% of total)	77 (70%)	18 (16%)	11 (10%)	4 (4%)
Alt. C units (% of total)	77 (70%)	18 (16%)	11 (10%)	4 (4%)
Alt. D units (% of total)	36 (69%)	9 (17%)	4 (8%)	3 (6%)
Alt. E units (% of total)	56 (82%)	8 (12%)	4 (6%)	0

* Percentage ranges are the aerial extent of activity area considered detrimentally disturbed from compaction or displacement.
** Number of units with percent of total units in parenthesis

Post-Fire Soil and Stand Conditions

Davis Fire Chronology and Characteristics

The Davis fire was started by human causes in June of 2003. The first episode of the fire occurred in the basin to the south of Davis Lake under moderate air temperatures and relatively low winds and burned approximately 15% of the total fire acres.

The second episode of the fire was driven rapidly to the north and east across the slopes of Hamner Butte and Davis Mountain by 30 to 50 mph ridge top winds. The large wind driven swath that resulted consists of high tree mortality and extensive litter, duff and crown needle consumption. Approximately 65% of the total fire acres were burned in this time period, primarily as a stand replacement event.

The third episode of the fire includes numerous acres of burnout from roads to the first and second episode portions of the fire. These activities covered approximately 20% of the fire area and generally underburned through stands while thinning smaller diameter fir and ponderosa via bole and crown scorch. Some areas of high intensity and stand replacement mortality are present within this portion of the fire.

Fire Intensity and Severity

Current direction and sideboards for Burned Area Emergency Rehabilitation (BAER) assessments of fire effects on the soil resource recommend the use of severity classes to describe the manner in which the intensity of the fire, described specifically as the heat released and flame lengths created during the combustion of fuels, has affected the soil resource above and below the surface mineral horizon (BAER website). Fire intensity was mapped by the BAER team according to the visual observations of the consumption or alteration of crown needles during the fire. Complete consumption of crown needles corresponds to high intensity; brown needles remaining correspond to moderate intensity and green needles remaining to low intensity. A summary of intensity was also mapped using BARC classification data received from a satellite image and is included in the Davis Fire Rapid Assessment (USFS 2003a) – see Map #2, page 7.

The determination of fire severity class by a BAER team is often integrated into a classification that best describes the overall post-fire effects of the burn on multiple resources. The integrated severity classification may inaccurately describe the fire's effects on individual resource's characteristics or on different characteristics of the same resource such as soil productivity and susceptibility to erosion. The severity classes of high, moderate and low included in the BAER manual speak specifically to post-fire soil resource characteristics such as litter and duff consumption, depth of ground char, presence and color of ash and woody debris consumption that were affected by the extent and duration of elevated soil temperatures during the event.

Fire severity classes can be interpolated to varying degrees from fire intensity classes mapped following the fire. Fire severity was mapped by the BAER team using observations of the effects of fire intensity on soil and vegetative conditions, as well as topography, as measures to determine the extent of change to soil productivity or watershed processes such as erosion, sediment delivery and peak storm flows. High inherent soil infiltration rates and observations of low 100 hr fuel consumption offset, to some degree, the complete consumption of surface litter and duff when changes to erosion and sediment delivery in the post-fire environment were considered. The relative lack of slope and defined drainages that could contribute eroded sediment to perennial streams or surface waterbodies across the fire area was also considered when applying severity ratings to the soil resource. Generally, Digital Elevation Model slope breaks were used to convert high and moderate intensity areas exceeding 25% to moderate severity, high and moderate intensity on slopes less than 25% to low severity and all low intensity to low severity.

During the BAER process a GIS layer describing fire intensity was compiled for the Davis fire area using aerial and ground observations of tree mortality and crown needle conditions. A LANDSAT image from the Remote Sensing Applications Center (RSAC) was later obtained by the District and used as the final intensity layer. This layer covers the entire fire perimeter and was used in making the burn severity layer for predictions of erosion rates and sediment yields.

Table 3.3 Fire Severity and Extent within Subwatersheds

Subwatershed (acres)	Burned acres within subwatershed (%)	Burned acres w/past Harvest activity	Soil severity (acres L/M)*	Hydro severity (acres L/M)**
Odell Ck. (13,830)	3,085 (23%)	695	3,061/47	1,791/1,266
Davis Lake (22,505)	8,146 (36%)	2,262	7,861/307	3,363/4,720
Davis Ck (17,639)	1,241 (7%)	573	1,209/17	813/408
Wickiup (26,965)	4,507 (17%)	2,499	4,421/31	2,675/1,781
Hamner Butte (13,360)	3,622 (27%)	1,530	3,521/64	1,826/1,763
Middle Crescent (18,052)	135 (0.7%)	29	131/0	79/48
Lower Crescent (20,145)	316 (1.6%)	153	308/0	261/30

* Soil severity refers to acres mapped by BAER relating to effects to soil productivity as a result of the duration and peak of temperatures reached during the fire. Only low and moderate classes were identified following the fire.
** Hydro severity refers to the erosion susceptibility of the soil resource based upon the condition or loss of surface cover following the fire. Acres were calculated from the BARC satellite image describing fire intensity.

Soil Severity: Erosion Susceptibility

In order to reflect the separate effects of the fire on soil productivity and the susceptibility to erosion, the amount and extent of detrimentally burned acres needs to be mapped separately from the acres of exposed mineral soil. Since the amount and extent of organic litter and duff consumption was observed to be directly related to the stand mortality characteristics following the fire, the intensity mapped by the BARC satellite image was used as a basis for describing severity as it relates to the hydrologic response of the subwatershed during precipitation events. This layer is used as a base for calculating annual post-fire soil erosion rates and losses related to changes in susceptibility to erosion due to the loss of effective ground cover.

Soil Severity: Productivity

Describing fire effects on soil productivity requires the use of detrimental burn conditions outlined in Regional Standards and Guidelines (FSM-2500, R6 Supplement 2500-98-1). Assessment in the field observed minimal amounts of mineral soil color change and below ground char and organic matter consumption associated with long durations of elevated temperatures capable of inducing a significant reduction in productivity. Areas mapped as low severity on the BAER severity layer were observed to have extensive ceanothus sprouting occurring after July rains and are not considered to have their productivity altered to a measurable degree. Areas mapped as moderate severity did not necessarily see greater durations of elevated temperatures but are located on slopes exceeding 25% that are slightly more susceptible to the loss of surface mineral soil during rain events. For these reasons, the BAER map of severity is used to describe the fire severity as it relates to changes incurred to the productivity of the soil resource by the fire event.

Fire Suppression and BAER Rehabilitation Operations

Dozer and Hand Line Construction

The construction of dozer and handlines during fire suppression activities has created detrimental post-fire soil conditions in the form of compaction and displacement within portions of the fire area. Approximately 23 miles of dozer line varying from 10 to 40 feet in width were constructed during fire suppression activities, equating to approximately 55 acres at an average width of 20 feet per line. These lines were observed to have variable conditions of displacement along their extent, generally averaging detrimental conditions from machine operations on 50% of their surface area. Rehabilitation of these areas during BAER operations constructed selectively located waterbars to dissipate overland flow energy but did not include actions to alleviate any compacted conditions.

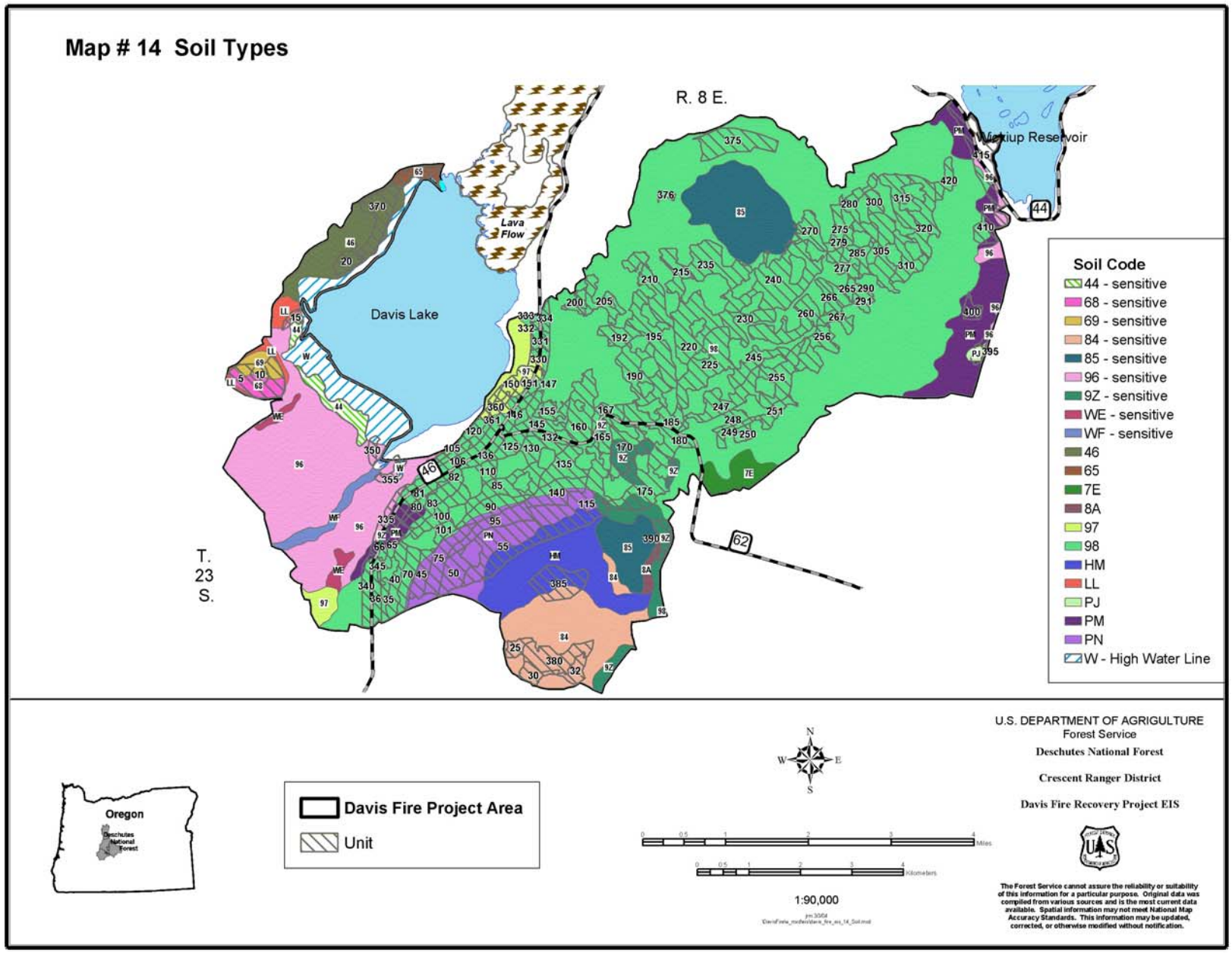
Handlines constructed during fire suppression efforts generally average 18 to 24 inches in width. Approximately 1,770 feet or 1/3 of a mile of handlines were constructed during suppression efforts, equating to less than 1/10th of an acre. These areas are devoid of organic cover and may be compacted from foot traffic egress during suppression and rehabilitation operations. Handlines had waterbars installed during suppression rehabilitation operations, with variable amounts of re-contouring or replacement of surface organics.

Retardant Drops

Fire suppression activities also included the use of fire retardant dropped on fuels in front of advancing flames. Applied retardants coat the surfaces of ground fuels, suppressing their complete flammability and promoting charring or carbonization of woody fuels. A total of 14 loads or 17,833 gallons of Fire-Trol LCG-R (Chemonics Industries) were dropped from airtankers within the fire perimeter on June 28th and 29th (Armour, personal communication). The loads dropped on the first day of operations were dropped within the Davis Lake basin, while the loads on the second day were dropped on the eastern flank of Davis Mountain along the 6220 road near the Wickiup Acres subdivision. A portion of one load may have dropped directly into Odell Creek during operations to anchor the southwestern line on the 28th.

Fire-Trol LCG-R is a liquid concentrate forms of retardant mixed at a 4.75 to1 ratio with water. Fire-Trol LCG-R is unthickened with Guar gum. The retardant is composed of ammonium salts of phosphate and sulfate, iron oxide used as a coloring agent and industry protected performance agents added to inhibit corrosion and spoilage, improve flow conditions and act as wetting agents. The Fire-Trol product contains yellow prussiates of soda (YPS), a corrosion inhibitor that contains sodium ferrocyanide shown to produce a weakly acidic, dissociable form of cyanide under exposure to ultra violet radiation (Little and Calfee 2002; CSIRO 2000).

Recommended application rates of fire retardant are 1.5 liters/square meter, although actual drop concentrations vary greatly depending on fuel loads and weather conditions at the time of flight. Using an average of 1,274 gallons per load at the recommended application rate gives an average of 0.80 acres covered per airtanker load. Assuming no overlap of drops, a maximum of (12 loads)(0.80 acres/load) = 9.6 acres of the project area were covered by retardant from airtanker drops.


Map # 14 Soil Types
R. 8 E.
T. 23 S.
Davis Lake
Lava Flow
Wickiup Reservoir
Soil Code
44 - sensitive
68 - sensitive
69 - sensitive
84 - sensitive
85 - sensitive
96 - sensitive
9Z - sensitive
WE - sensitive
WF - sensitive
46
65
7E
8A
97
98
HM
LL
PJ
PM
PN
W - High Water Line
Oregon
Deschutes National Forest
Davis Fire Project Area
Unit
N
S
E
W
Miles
Kilometers
1:90,000
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS
The Forest Service cannot assure the reliability or suitability of this information for a particular purpose. Original data was compiled from various sources and is the most current data available. Spatial information may not meet National Map Accuracy Standards. This information may be updated, corrected, or otherwise modified without notification.

Retardant Transformations

Heated retardant: The actual amount of nutrient input into the soil system depends on any heat-initiated transformations of retardant components and any subsequent volatilization of these transformation products. When retardant is heated to temperatures up to 200 degrees Centigrade, ammonium salts of sulfate and phosphate are converted to sulfuric and phosphoric acids, producing sulfur dioxide, ammonia and oxides of nitrogen in their gaseous forms. Some of the sulfuric and phosphoric acids produced may be volatilized under temperatures capable of occurring under wild-land fire conditions. Under extreme fire temperatures exceeding 600 degrees centigrade, ammonium salts of sulfate and phosphate would likely decompose to oxides of nitrogen, sulfur dioxide and P2O5, although most of the retardant would not have been exposed to such temperatures (CSIRO 2000).

Retardant residues remaining following the fire likely contain some form of heat-modified products of the original retardant components previously listed. The performance additives may be oxidized or little affected, depending on the temperatures of the fire. Although little information has been provided by the chemical companies or is available in the literature on oxidation mechanisms or the solubility and potential toxicities of performance additives or their products created by temperatures reached during wildfire, these compounds require high temperatures for complete decomposition and some of these retardant products are likely to be contained within ash left behind on the surface. Limited sub-lethal concentrations of dissociable and iron bound cyanide were measured in aqueous leachates of ash derived from combusted organics covered with Fire-Trol residues (Little and Calfee 2002).

Unheated retardant: Specific pathways for the three primary nutrient components are also outlined for unchanged or unheated retardant (CSIRO 2000). Pathways for unaltered performance agents are not well documented, although UV radiation has been shown to release lethal levels of cyanide from unaltered retardant containing YPS (Fire-Trol LCG-R) in streams or lakes. The guar gum thickener component is assumed to undergo oxidative decomposition and likely decomposes to carbon dioxide and water, while the iron oxide coloring agent would remain largely unaltered with negligible effects on soil processes (CSIRO 2000).

Nitrogen could be added to the system as ammonium from unheated retardant concentrations that could be greater than the rate at which growing vegetation can take it up. Much of this ammonium nitrogen would be converted to nitrates that are mobile within the soil profile and likely leached to the groundwater where concentrations would be diluted to some degree before resurfacing in a stream or surface waterbody. The leaching of nitrates can also cause a slight acidification of the soil due to losses of base cations.

Phosphorus and sulfur in unaltered retardant are water-soluble and would likely enter the soil solution in the absence of large storm events capable of creating overland flows. Phosphorus is readily adsorbed onto mineral or organic sites while most soils have a very low capacity to retain sulfur, especially when it enters the soil together with phosphorus. Much of the sulfur entering the soil profile could be leached into groundwater in a sulphate form.

Chemical and Biotic Components

In order to assess changes to the chemical and biotic components of the soil resource as a result of the fire, they must be defined as measurable entities capable of showing change. These components include the pool of nutrients contained within the soil matrix and soil organic matter along with bacterial and fungal microbial populations. Major nutrients such as carbon, nitrogen, phosphorus and sulfur are also contained in above ground organics and vegetation within the forest system. Changes to on-site pools of carbon and nitrogen as a result of fire are obvious within the above ground portions of the system but less apparent or reasonably measured within the soil portions of the system.

For this analysis, the ratio of soil carbon to soil nitrogen (C:N) is used to define changes to the below ground chemical component of the soil resource since many microbial and plant growth processes are influenced by this ratio. Effects of the fire on soil productivity and microbial activity can be directly measured or induced from this ratio. For above ground nutrient pools, research using destructive sampling of nutrient budgets contained within ponderosa pine forest systems was used as baseline, pre-fire levels from which amounts consumed by the fire were subtracted to calculate current, post-fire levels.

Pre-fire above ground nutrient site budgets: Total nutrient site budgets of forested systems include above and below ground organic and mineral components that contain the primary nutrients in a variety of forms. Long-term productivity plots on the Deschutes National Forest in a second growth, 50 to 70 year old ponderosa pine stand west of the town of Bend had their above-ground vegetation, forest floor residues and litter and duff destructively

sampled and found to contain approximately 54% total carbon, 15% total nitrogen, 4% total sulfur and <1% total phosphorus stored on site.

Fire induced losses of above ground nutrients: The consumption of above ground vegetation, residues and forest floor litter and duff by the fire removed components of the nutrient pool that contain high concentrations of nutrients but a relatively low percentage of the total content of these nutrients on site. The largest and most quantifiable nutrient losses from the fire are those contained within above ground biomass consumed by the fire. The loss of carbon contained in above ground vegetation and larger residues on the soil surface was calculated as an average of 100% of the coarse wood residues, 60% of the tree crown component and 20% of the tree bark component on site. Losses at these levels are calculated to be approximately 31% percent of total C and 11% of total N on site, and 59% of above ground C and 82% of above ground N on site. Fire losses at these consumption rates account for less than 1% total P and <3% of total S on site.

Nitrogen levels present in ash left behind on the soil surface in the Entiat fire were measured to be only 3% of that contained in pre-fire forest floor litter and duff, translating to a potential loss of 133 lbs/ac N from the consumption of litter and duff (Grier 1975; Little and Shainsky 1995). While the ash left behind on the soil surface contains small amounts of nitrogen, there are significant amounts of cations such as calcium, magnesium, potassium and sodium remaining behind in this material that was associated with the more readily volatilized anions containing P and N (Grier 1975). Losses of carbon contained in litter and duff was nearly 100% of this component and could total approximately 7,140 lb/ac (Little and Shainsky 1995). Measured and estimated losses or transformations of nutrients as a result of the fire, as well as post-fire inputs into the system are discussed under Long-term Site Productivity and summarized in table 3.6 under the No-Action Alternative.

Pre-fire below-ground nutrient budgets and C:N ratios: The soil profile also stores additional amounts of the primary nutrients carbon, nitrogen and phosphorous within the system. Levels of these nutrients were measured in Mazama ash soils beneath second-growth ponderosa pine stands to be 78 million grams/acre C (40% total C); 3,355 lbs/acre N (85% total N); and 8,926 lbs/acre P (99% total P) (Little and Shainsky 1995).

The soil profile in these forest systems contains lower concentrations of carbon, nitrogen and sulfur than the above ground organic components but stores a significant amount of the total budget of these nutrients, especially phosphorus, on site. The surface horizons in these soils contain up to 30% of total soil borne carbon and 25% of total soil borne nitrogen in these systems (Little and Shainsky 1995). Carbon to nitrogen ratios of a forested system can be calculated using amounts contained within the soil profile only or including live roots and the surface litter and duff. A functional site C:N ratio reflecting soil productivity utilizes carbon and nitrogen contained in the mineral surface A1 and A2 horizons. This equates to a pre-fire ratio of soil borne carbon and soil nitrogen of approximately 30:1 in east side systems (Busse, personal communication).

Calculations utilizing amounts measured from the destructive sampling of plots within second growth ponderosa pine stands measured C:N ratios of 24:1 using amounts contained in the surface mineral horizons and 30:1 when live roots and surface litter and duff were included (Little and Shainsky 1995). Soil biota that include bacterial and fungal populations are likely present within these soils at levels similar to those measured on the Deschutes Long-Term Productivity Plots within Mazama ash derived soils (Busse, personal communication).

Fire induced losses of below ground nutrients: Changes in the chemical and biotic components as a result of the fire relate directly to the intensity and duration of heat generated during the event. The losses of nutrients contained in the soil profile are difficult to measure and likely quite variable across the fire area. The greatest losses occurred in areas where mineral soil discoloration was observed under down logs or old stumps where extended durations of temperatures capable of volatilizing these nutrients occurred. Soils in these areas are likely to have had a measurable duration of temperatures in excess of 800 degrees C capable of volatilizing nutrients in solution, soil borne organic matter and fungal and bacterial populations. These conditions were observed to comprise a very limited amount of the fire area due to the rapid movement of the fire and relatively low consumption levels of 1,000 hour fuels. Areas where extended durations of elevated temperatures did occur will likely have had conditions similar to those measured in the top 2 cm of mineral soil underneath burn piles in Mazama ash material on the Bend and Fort Rock Districts. These areas exceeded 100 degrees C for more than 12 hours and reached peaks of between 300 and 450 degrees C during the first 20 hours in some plots (Sheay 1993).

Although the fire burned during a very dry mid-summer period when fuel moistures were quite low, the poor conductance characteristics of soils derived from ash and pumice, especially when soil moistures are below field capacity, likely kept temperatures within the soil profile well below 800 degrees Centigrade for the majority of the area. Within the top few centimeters of the soil profile, hydrophobic soil properties following the fire were not

observed to any measurable extent above natural levels present under low soil moisture conditions. The depth and amount of below ground charring was also observed to be relatively low throughout the fire area.

Fire induced changes in C:N ratios: Losses of soil borne carbon and nitrogen from the fire are estimated to be similar to levels measured in soils derived from ash on other fires located on east-side forest landscapes within the region. Immediate post-fire nitrogen levels measured in the A1 horizon of soils within the Entiat fires of 1970 were nearly 66% of natural pre-fire amounts. Losses of nitrogen at these rates could total as much as 160 lbs/ac N from the A1 horizon (Grier 1975). Quantifying the loss of soil carbon is more difficult but could be as high as 10,000 lb/ac if 50% of the carbon contained in the A1 horizon was combusted.

The consumption of soil borne carbon and nitrogen contained in the A1 horizon by the fire could reduce the amounts of these nutrients considered for a functional C:N ratio by 50% for carbon and 33% for nitrogen. Inferring changes to the soil borne C:N ratio following the fire is difficult because nitrogen volatilizes at low temperatures and incompletely mineralizes to plant available ammonium at levels up to double that of those prior to the fire (Clark 2001). The flush of available nitrogen following the fire will initially indicate a more active system in terms of nutrient availability reflective of a reduced C:N ratio for the first year, although the system will likely return to a soil C:N ratio similar to pre-fire levels within a year or two. Since there was 20 to 30 times the amount carbon than nitrogen under pre-fire soil conditions, the total losses for calculating changes in C:N ratios are likely very similar and the ratio is not considered to have changed significantly for the years following the initial nitrogen flush within the system.

Fire induced losses of soil biota: The loss of fungal and microbial populations and inorganic forms of nutrients in soil solution occurred to varying degrees throughout the fire area but is also difficult to quantify across the fire area. Studies at the Awbrey Hall and Mt. Lassen fire sites showed minimal short and long-term effects on bacterial populations and only short-term declines in fungal populations following wildfire (Busse, personal communication). Losses of microbial and fungal populations from direct consumption or heat-induced mortality are likely to have occurred to some degree within the first five centimeters of the mineral soil where complete consumption of the forest floor litter and duff occurred. Despite this degree of consumption within much of the wind driven fire swath, heat penetration down into the soil profile appears to be limited due to the rapid movement of the fire through these areas and the low heat conductance of the pumiceous soil present. Many fine roots located within a few centimeters of the soil surface were observed to have survived the fire intact in many areas (Davis Fire, BAER Soils Specialist Report, 2003). In addition, although ectomyccorhizae associated with root tips of conifers, herbaceous shrubs and perennials located further down in the soil profile have lost their live root hosts, they were not directly damaged by the fire and may linger as a saprophyte until a live host returns. ***The post-fire soil environment is likely to have maintained a level and diversity of soil biota capable of utilizing dead organic matter as saprophytes and re-colonizing live root systems as vegetation re-sprouts on site*** **(Smith, personal communication).**

Environmental Consequences

Summary of Effects Analysis

Effects analysis of the alternatives developed for the Davis Fire Recovery Project EIS addresses the physical, chemical and biological components of the soil resource. Forest Plan Standard and Guidelines require that proposed management activities minimize detrimental disturbance to the soil resource to less than 20% of an activity unit area in order to maintain conditions conducive to processes that comprise soil productivity.

As described under the existing condition section of this report, the fire event has altered the chemical and biological components of the soil resource to varying degrees as a result of the direct combustion of organics and heat generated during the event. A relatively small area of the soil resource within the project area was also physically altered as a result of fire suppression activities. The rehabilitation of dozer lines and safety areas has occurred to offset some of these suppression impacts.

The No Action alternative (Alternative A) would perpetuate existing physical conditions and allow the return of the vegetative component to occur unimpeded or enhanced by management activities. The chemical and biological components of the soil resource would recover in response to the natural return of coniferous trees and herbaceous vegetation on site. Areas proposed for salvage and fuels treatments under the action alternatives would have a large build up of coarse woody material on the soil resource between 20 and 40 years from now under the No Action scenario. These conditions could be of concern for microbial activity associated with nutrient cycling due to

excessive increases in carbon to nitrogen ratios on the soil surface. This has the potential to shift microbial activity priorities to above-ground versus below-ground cycling.

The action alternatives developed include proposed salvage and fuels treatment activities that would have direct, indirect and cumulative effects on the soil resource. The extent of these effects varies between alternatives as a result of differences in logging systems and the number and location of units. Helicopter yarding is a component of action alternatives B, C and E in order to reduce soil disturbance associated with mechanized harvest and yarding operations. Detrimental disturbance to the soil resource is expected to occur within allowable standards and guidelines for the majority of activity units following proposed activities. Subsoiling mitigation measures would be implemented to reduce detrimental disturbance in ground-based units exceeding the 20% standard following proposed activities.

The environmental consequences of the alternatives included in the Davis EIS are described as effects to the physical, chemical and biological components of the soil resource. Changes to the physical component of the soil primarily occur as compaction and displacement incurred by management activities involving machinery traffic over the native soil surface or the dedication of soil areas to roads. Compaction and displacement from past management activities, fire suppression operations and activities proposed under this EIS is quantified as the aerial extent of measured or predicted detrimental conditions within an activity area.

Changes to the chemical and biological components of the soil resource are primarily affected by the manipulation and removal of organic matter on site, but can also be altered by detrimental disturbance incurred by management activities. Effects to these components are tracked by describing changes in the composition and quantity of live and dead organic matter composition on site, calculating levels of detrimental disturbance levels across the project area or within activity units, and summarizing transformations of soil nutrients and biota as a result of the fire intensity and severity.

Alternative A - Physical Component

The No Action alternative would incur no additional compaction or displacement to the soil resource beyond levels present following fire suppression efforts. Risks of erosion from water and wind mechanisms are elevated with the loss of organic surface and canopy cover capable of reducing raindrop impacts and overland flow energies. . The presence and rate of return of effective ground cover provided by live vegetation and down wood would occur under unmanaged conditions as pathways of succession were completed.

Erosion Risks

The primary effect of the fire on the physical component of the soil resource was the loss of surface cover provided by litter, duff and live vegetation. This loss elevates the risk of sheet and rill erosion during rainfall events across all of the burn severity classes within the fire perimeter until surface cover in the form of live vegetation, organic litter fall and woody debris increases to a level capable of reducing rain drop impacts and slowing overland flow accumulations and energies. The presence of 1,000 hour fuels larger than 3” throughout the fire area provides surface roughness on many slopes that will slow overland flows and prevent large rills or gullies from forming unimpeded.

The severity of the burn is not considered to have incurred detrimental damage extensive enough to limit vegetative re-establishment with annuals, perennials, and herbaceous shrubs expected to return at successional rates observed at other fires on the Forest, including McKay and Pringle, as well as other fires on eastside Forests. Vegetative recovery to pre-fire cover values occurred after three to six years for similar fire severities on the Okanogan National Forest (Radek 2001). Field observations during the fall of 2003 have shown considerable re-growth of native herbaceous shrubs throughout the fire area.

Risk of erosion includes increased rates of upland losses from rill and sheet erosion and possible sediment yields to stream courses within a watershed. While erosion rates and sediment yields can increase significantly following the loss of effective cover, measured erosion rates and sediment yields decreased significantly after two to four years in numerous studies following wildfires, primarily as a result of revegetation (Robichaud 1999; Radek 2001). Recovery of coniferous vegetation and the cover that it provides within the burned subwatersheds would be slowest under this alternative since this alternative relies solely on natural regeneration.

Water Erosion Rates

Predicted erosion rates following the fire for the primary burn severity classes across the fire area were calculated using a model entitled "Guidelines for Computing Quantified Soil Erosion Hazard and On-site Erosion" (Anderson 1989). The guideline outlines two methods for determining the Erodibility Coefficient for use in the Erosion Hazard Tables, including the Soil Erodibility index calculation which follows standard soil survey techniques as described in the Forest Service Handbook and the soil component of the California Region Erosion Hazard Technique.

Calculations used to predict erosion rates and annual losses for this analysis generalize the soil types across the burned area with the following assumptions: average depth of soil profiles is deep (> 40 inches) with pumiceous loamy sand surface textures (coarse texture) and a very rapid permeability class. Table 3.4 summarizes predictions for pre and post-fire erosion rates from upland locations with representative vegetative cover for years in which a 2yr 30 minute or 100yr 30 minute storm occurred. Calculations of erosion rates and hazards are found in Appendix B of the DEIS.

Table 3.4 Predicted Pre- and Post-fire Annual Upland Erosion Losses on 20% Slopes by Storm Type

Storm type *	**Predicted annual erosion losses in tons/acre (% increase) *** **			
	Unburned **	Low severity	Moderate severity	High severity
2 yr 30min.	0.016	0.046 (187%)	0.156 (875%)	0.31 (1,837%)
100 yr 30 min.	0.19	0.59 (210%)	1.87 (884%)	3.6 (1,794%)

* Precipitation amounts for 2yr 30 minute and 100yr 30 minute recurrence interval storm types for the analysis area are 0.258 inches and 0.826 inches, respectively (Miller, et al. NOAA Atlas 2). Annual losses are predicted for a year in which a storm of this magnitude occurred.

** Predicted annual erosion loss values for unburned conditions assume an average of 80% aerial cover capable of intercepting raindrops, 45 to 74% of which is considered to be effective ground cover. Average ground and standing aerial cover capable of intercepting raindrop impacts for high, moderate and low burn severities were 20, 30 and 50%, respectively.

*** Post-fire erosion losses for low, moderate and high burn severities are for first year conditions without significant (<20%) return of vegetative cover. Percent increases over unburned conditions are included in parenthesis.

The predicted annual erosion loss of 0.016 tons/acre under a 2yr 30 minute storm scenario for undisturbed conditions correlates reasonably well with the sediment yield of 0.028 tons/acre measured in the stream outflow of an undisturbed watershed on the Umatilla National Forest (Helvey and Fowler 1997). The coarseness of the pumiceous sandy loam material, as well as the lack of significant slopes present in this project area combine to reduce the amount of soil eroded and the transport distances when compared to the Umatilla area studied. The predicted annual erosion loss of 0.19 T/acre under a 100yr 30 minute recurrence interval storm pattern also appears to be a reasonable figure for the soils present under undisturbed pre-fire conditions.

Predicted increases in first year, post-fire upland erosion rates on slopes of 20% for both recurrence interval storm types for the low, moderate and high burn severity classes are approximately 2, 9, and 18 times greater than the predicted rate under pre-fire cover conditions. These predicted increases correlate reasonably well with research of post-fire sediment production from lower intensity storms (Potts et al. 1985; Noble and Lundeen 1971) and higher intensity storms (Robichaud 1999, 2000; Radek 2000) during the first year following a significant, cover-reducing fire event. Total sediment captured by traps for these studies ranged from 1.5 to 11.60 Tons/acre on various slope grades, with larger amounts primarily associated with high precipitation events exceeding an inch within a 24-hour period.

Erosion rate calculations were also done for slopes up to 5% to simulate conditions within the 480 ft sediment delivery zone along Odell and Ranger Creeks and the shores of Davis Lake. Table 3.5 summarizes these numbers for this zone. Predicted increases are similar to those calculated for upland slopes averaging 20%. Erosion rates presented here are used for calculating actual sediment delivery amounts to these waterbodies in table 3.6

Table 3.5 Predicted Pre and Post-fire Annual Upland Erosion Losses on 5% Slopes by Storm Type

Storm type*	**Predicted annual erosion losses in tons/acre (% increase)*** **			
	Unburned**	Low severity	Moderate severity	High severity
2 yr 30min.	0.0015	0.0046 (206%)	0.015 (900%)	0.031 (1,966%)
100 yr 30 min.	0.016	0.062 (287%)	0.187 (1,068%)	0.375 (2,243%)

Direct Effects of Surface Erosion

Productivity

Natural Resource Conservation Service (NRCS) T-values for soil map units express allowable annual loss in tons/acre before productivity would be negatively affected. NRCS mapping from the Upper Deschutes Soil Survey includes soils located immediately to the east of the project area, including the Steiger series which is comprised of the same surface and subsurface material that is mapped as SRI unit 98 within the project area and the Tutni series which correlates reasonably well with the surface and rooting zone horizons of SRI map unit 96 in the lodgepole basin and SRI units 43 and 44 on the terraces along Odell and Ranger Creeks. The T-value for the Steiger and Tutni series is 5 tons/acre. ***Predicted overland erosion rates for a 2-year recurrence interval storm are well within these allowable losses for all map units under current cover conditions following the fire*** (table 3.5).

Predicted rates for moderate and high burn severity classes under a 100yr recurrence interval storm currently are also within the allowable T-value losses for all map units. Rates of loss under a large storm event range from 8 to 18 times the pre-fire rates and would continue to be elevated until organic litter and live vegetation returned to provide approximately 40 to 60% effective ground cover. The re-growth of herbaceous vegetation already observed during the late summer and fall of 2003 indicates that the return of vegetative cover within the fire perimeter would likely occur at post-fire rates observed within other fires of similar extent and severity (Eyerly Soils Report, Sussmann 2003). ***Vegetative cover capable of reducing the erosion loss rates to pre-fire levels for a 100yr storm type will likely return over the majority of acreage within three to six years***.

Effective Ground Cover

The return of effective ground cover provided by herbaceous vegetation, litter and duff, and coarse wood would occur on all soils in the project area without any additional management activity. The germination and re-sprouting of herbaceous species on site varies throughout the fire but is observed to be occurring on all classes of burn severity identified following the fire. Continuation of this growth is expected to occur over the next decade as herbaceous annuals are succeeded by perennials and shrubs on site. Cover values provided by vegetation on the Eyerly fire exceeded 50% on many areas after the first full growing season and up to 90% after two growing seasons. Initial growth on the Davis fire follows this trend in many areas, although values of less than 50% are present in some areas as of mid- summer of 2004. Effective ground cover would be expected to return to levels recommended under the LRMP standard SL-6 within the next few years.

Sediment Yield

Changes in sediment yields to streams from overland erosion processes as a result of the fire correspond directly to altered erosion rates associated with the loss of surface cover. Davis Lake, Wickiup Reservoir, Odell Creek and Ranger Creek are the surface waterbodies within the project area that could receive sediment eroded from adjacent riparian and upland locations. Actual sediment yield to a stream course is generally a small percentage of the total material eroded within a watershed and is primarily contributed from within a buffer width of up to 480 feet from the water edge, unless a tributary drainage or road conduit provides hydrologic connectivity from further away.

Estimated sediment actually delivered to the stream courses from upland sheet and rill erosion is generally recognized as a percentage of the total produced within a subwatershed. For alternative comparisons under this analysis, the percentage of eroded sediment actually delivered to stream channels was modeled after tables from the Q/D technical Note #1 derived from PSWHA I and those used in the Tower Fire Report (Umatilla National Forest, 2001), which define sediment delivery buffers extending up to 480 feet on either side of stream channels. The

percentage of sediment delivered to stream channels for that analysis was estimated to be 30, 20 and 10% of sediment produced within delivery buffers located 0 to 160, 160 to 320 and 320 to 480 feet, respectively, from the channel. An average of 20% of calculated sediment produced within 480 ft of the water edge was used for this analysis.

Calculations used to estimate changes in first year sediment yield to the primary intermittent and perennial stream courses in the project area include the adjustment of annual per acre loss amounts to account for sediment captured by barriers provided by surface roughness and physical distances from the waterbodies in question. Actual amounts of sediment delivered to stream or lake bodies for this analysis were calculated to be 20% of that predicted to erode from burned areas within 480 ft of the water edge. Table 3.6 summarizes changes in predicted annual sediment yields to stream courses and waterbodies in the project area between pre-fire and first-year, post-fire conditions. Yields are calculated for a year in which a 2yr 30 minute recurrence interval storm occurred.

Table 3.6 Predicted First Year Changes in Sediment Yields to Stream Courses from within Burned Area

Waterbody	Total Acres within 480 ft	Burned Acres within 480 ft	Est. Pre-fire Sediment Delivery *	Est. Post-fire Sediment Delivery	Temporary % Increase
Odell Creek	1,548 ac	234 ac	(0.35 Tons)(.2)=0.07 T	(3.5 T)(.2)=0.70 T	900%
Ranger Creek	564 ac	148 ac	(0.22 Tons)(.2)=0.04 T	(2.3T)(.2)=0.46 T	1,050%
Davis Lake	713 ac	396 ac	(0.59 Tons)(.2)=0.12 T	(6.1T)(.2)=1.22 T	916%

* Predicted pre and post-fire sediment delivery rates are for first year vegetative cover conditions based upon erosion rates predicted for a 2 yr recurrence interval storm event. Total acres within the 480 ft delivery zone burned by the fire are multiplied by erosion rates presented in Appendix B, for slopes up to 5%. Sediment actually delivered to a waterbody is calculated as 20% percent of that eroded within the 480 ft transport zone.

The low pre-fire rates predicted are supported by low sediment loads historically carried by Odell Creek and the lack of sedimentary deposition within the lakebed of Davis Lake (Phillips 1968). Observed channel substrates are coarse gravels and small cobbles without many fines (Powers, personal communication). Although predicted first year sediment delivery totals are 9 to 10 times pre-fire rates, the actual amounts predicted are very low and would be processed by the stream volume as bedload material. In addition, the combination of a number of physical factors surrounding Odell Creek, Ranger Creek, and Davis Lake suggest a low risk of sediment delivery to these waterbodies as a result of the fire. Although a portion of the soils within the sediment transport zone (SRI units 43 and 44) are considered to be in Hydrologic Group C due to a high, seasonal water table, surface permeability rates are considered to be very rapid to rapid and thunderstorm events capable of producing significant rainfall generally occur during the summer months when soil moistures are low. Slopes along each of the surface waterbodies within 480 ft average less than 2%. No roads cross either of the perennial streams within the fire perimeter, and the few low lying areas present along Odell Creek within the fire perimeter are wider, diatomaceous covered areas once flooded by beavers that do not appear to flow surface water. ***As a result, the actual amounts of sediment delivered to the surface waterbodies from burned areas during rainfall events is likely to be relatively low when compared to exposed soil sources along steeper and more dissected drainages. Rates of delivery will decrease steadily as cover provided by vegetative re-growth and downed coarse woody debris reduces raindrop impact and overland flow energies.***

Wind Erosion

Erosion risks associated with wind have increased following the loss of cover throughout the Davis fire area. NRCS wind erodibility groups indicate the susceptibility of soil to wind erosion, with those assigned to group 1, 2, or 3 the most susceptible to this mechanism. The majority of the soil surface following the fire is comprised of a mixture of ash from the fire and mineral pumiceous, loamy coarse sand volcanic depositions. Ash material is included in erodibility group 2 and mineral loamy coarse sands are included in erodibility group 1.

Dust devils comprised of surface soil material were observed frequently during the late summer and early fall months following the fire. Although the ash deposited as a result of the fire contains cations such as calcium, magnesium and potassium that have higher volatilization temperatures than the anions associated with them (Busse, personal communication), ***the loss of ash and soil material from this process are not expected to exceed allowable T-values or significantly reduce the productivity of these soils***. The risk and rate of soil loss from this mechanism would decrease steadily over time as vegetative re-growth continues to increase ground cover each year and organics accumulate on the soil surface.

Compaction and Displacement

Compaction levels within the project area would remain the same under this alternative since no ground-based salvage operations or subsoiling of compacted areas would occur. ***The majority of stand areas within the fire perimeter have levels of detrimental disturbance below the 20% Regional Standard and would continue to function as productive sites*** (tables 3.1 and 3.2). The risk of further impacts from machinery involved in a fire suppression effort would increase slightly under this alternative as the potential for reburn increases from the accumulation of fuel loads provided by downed trees killed by the fire.

Current motorized access to this area would not change under this alternative. Roads opened for fire suppression activities have been re-closed but have lost visual barriers to breaches from Off Highway Vehicles. Potential for impacts to the soil resource, primarily as displacement of surface mineral soil, from motorized trespassing off of existing open and closed roads has increased from pre-fire conditions and would be elevated until shrub regrowth and fallen trees provided visual and physical barriers to travel.

Alternative A - Chemical and Biological Components

The chemical and biotic components of the soil resource in the post-fire environment would recover under conditions excluding the physical removal of any additional organic matter on site. No further machine traffic would occur off of existing roads for the foreseeable future.

Carbon to Nitrogen ratios

The ratio of soil borne carbon and soil nitrogen within a forested system influences microbial activity associated with plant uptake and cycling of nutrients and is functional for reflecting the relative amount and type of activity of microbial populations that influence these processes. Lower C:N ratios are favorable to microbial activities associated with cycling nutrients into plant available forms while higher ratios tend to tie up microbial populations in processes of lignin breakdown. Levels within managed eastside forests have been measured ranging from 20-30:1 (Busse, personal communication; Little and Shainsky 1995).

The conversion of organic nitrogen to available inorganic ammonium nitrogen during the fire (Clark 2001) could initially indicate a more active microbial system reflective of a reduced C:N ratio. The utilization of this available nitrogen by herbaceous shrubs re-sprouting and annuals, perennials, and shrubs sprouting from seed sources that survived the fire will likely equilibrate the system to a soil C:N ratio similar to pre-fire levels within the next year or two. After the nitrogen flush and utilization is completed, the fixation of atmospheric nitrogen associated with ceanothus species would become the primary source of mineralizable nitrogen until organic sources grown on site became more prevalent. Vegetative re-growth would provide a photosynthesized source of carbon that would begin to contribute to soil-borne carbon levels reduced by the fire. ***Overall, the soil C:N ratio would be expected to be close to that of pre-fire levels as the system adjusts to the altered rates of input for these two nutrients.*** Since the No-action alternative would be the slowest to return trees on the acres proposed for salvage under other alternatives, there would be a delay of 10 to 15 years in the input of nutrients contained in conifer needles on these sites. Additional carbon contributed by fallen trees would raise the coarse woody debris levels on the surface to very high levels after twenty to forty years. The elevated woody source of carbon on the surface could divert microbial activity from nutrient cycling to the breakdown of lignin in the system.

Soil Biota

Effects to the biotic component of the soil resource relate directly to the heat induced mortality of soil biota and indirectly to changes in the C:N ratio on site. Laboratory measurements of soil samples collected at the Awbrey Hall and Mt. Lassen fire sites showed minimal short and long-term effects on bacterial populations and only short-term declines in fungal populations following wildfire (Busse, personal communication). The immediate recovery of microbial populations would likely be focused on species specific to inanimate hosts such as coarse woody debris and dead organic matter. The diversity and number of microbes are likely to increase as vegetative hosts return and provide live roots to colonize.

Mycorrhizal populations are difficult to measure since their mycelium are relatively ubiquitous and generally associated with live vegetative root tips. Research associated with fall and spring underburns indicates that there is a diverse number and specificity of mycorrhizal fungal species in east-side forest systems, including a handful of primary species found to occur regularly (Smith, personal communication). Ectomychorrizal fungi are important for influencing phosphorus availability in P-deficient soils (levels below 30 ppm) and their ability to resist root pathogens such as phytopthera species. They are also integral to the uptake of other nutrients and water by plant roots in ash or pumice soils. Their return in the post-fire environment has been documented by a number of means, including spore releases from compact propagules of mycelium called sclerotia, mycelial growth from populations located far enough below the soil surface to resist combustion or heat pulses from a fire, and re-colonization as a result of mammal ingestion of truffle species off site and subsequent defecation within the fire perimeter (Molina and Smith, personal communication). ***The loss of live root hosts for conifer specific ectomycorrhizae species may initially reduce populations that cannot morph into a saprophytic stage and will tend to support species and life-cycle stages capable of obtaining nutrition from dead organic matter.*** The recovery of various ectomycorrhizal species and mycelial stages within the fire perimeter is expected to occur steadily as vegetative re-growth, especially conifer seedlings, begins to function as hosts for these fungi.

Other fungal populations are also likely to rebound in subsequent years following the fire. Morel mushrooms returned on the Eyerly fire (July 2002) located on the Sisters District during the spring of 2003 at variable levels throughout the mixed conifer and upper ponderosa pine Plant Association Groups (PAGs). The Davis and Hamner area is known to have morel populations (Peterson, personal communication) and their presence on the District is supported by past sales of commercial morel permits for the Muttonchop and Little Deschutes fires. Morel life cycles appear to include both saprotrophic and mycorrhizal phases, both of which can produce the ascocarp fruiting bodies for which they are prized. Dead roots in the post-fire environment are conducive to the saprophytic form of morels, during which nutrition is obtained from dead organic matter (Dahlstrom, et al. 2000). Post-fire recovery is likely to occur from spores released in response to heat generated during the fire from compact pellets of mycelium called scerotia that were not consumed by the fire (Smith, personal communication).

Surface Organics and Soil-Borne Carbon

The post-fire return of surface organics (litter and duff) and soil borne carbon is directly related to the presence of vegetation to provide these components to the soil resource. Although the majority of the fire consumed crown needles completely, there are some areas where unconsumed needles on burned trees have already accumulated on the soil surface. The post-fire return of annual and perennial vegetative species is expected to continue to occur at natural post-fire rates under this alternative, contributing fine-sized organic material on the soil surface and within the mineral soil rooting horizons. Substantial amounts of ceanothus and chinquapin have re-sprouted and grown during the late summer and fall of 2003 and seed sources of annuals, perennials and shrubs are expected to re-populate as pioneer species in the post-fire line of vegetative succession. The establishment of these species will provide a primary source of soil carbon and nutrients in the first number of years following the fire. Soil functions such as moisture retention, microbial nutrient breakdown and translocation, and surface stabilization will recover to varying degrees as these species carry out their seasonal cycles and are incorporated into the mineral soil.

The rate at which conifer seedlings and their associated organic litter inputs would return to the site would be reduced when compared to the action alternatives since no replanting would occur. Conifer seeds produced the year of the fire had not matured at the time of the burn and the survival of seed caches from small mammals is not known at this time. Rates of natural regeneration within plant association groups have been predicted (Volland 1988) and are summarized in the silviculture report (Powers 2003). Mixed conifer stands are predicted to generate 10

lodgepole seedlings per acre during each decade into the future within interior locations, while lodgepole stands are predicted to generate up to 1,000 trees per acre over the first decade. The return of 30% canopy cover within mixed conifer stands would be expected to exceed the 30 to 40 year period predicted within planted stands under the action alternatives by greater than 20 to 30 years (Powers 2003).

Coarse Woody Debris

Coarse woody debris functions to help retain moisture on the soil surface, create microbial habitat and provide a long-term sink of nutrients for microbial conversion and subsequent plant uptake. A variable amount of this component remains on the soil surface throughout the fire area, generally ranging between 3 and 20 tons in a subset of proposed activity units (Owens 2004). More of this material will continue to fall during windstorms and from general rot. Ten years following the Lone Pine Fire on the Winema National Forest approximately 90% of standing dead under 14" dbh and 50% of material over 14"dbh was measured to have fallen to the ground in two unlogged stand replacement mortality ponderosa pine sites (Winema Monitoring, 2002). Carbon available to microbial populations for lignin breakdown and nutrient cycling would also increase from this accumulation, depending primarily on the magnitude of wind events over the decade.

Despite variable charring from the fire, coarse wood remaining on site should function normally as microbial habitat and as a source of nutrients in the short-term until more wood is provided by windthrown trees killed by the fire (Graham et al. 1994). Research has shown a direct relationship between the amount of active ectomycorrhizal root tips and the level of coarse woody debris on site, with an optimal coarse woody debris level for ectomycorrhizal activity in a ponderosa pine/Arizona fescue association of 7 to 14 tons per acre (Graham et al. 1994). ***Coarse woody debris on the surface in some areas of the fire under Alternative A may initially be deficit in fulfilling productivity roles associated with mycorrhizal relationship until snags begin to fall to the ground from wind throw events.*** Levels would likely increase after a decade or more as root rot reduces snag resistance to wind events. Total levels of large coarse wood (>12" dbh) on the ground could range up to 20 tons per acre within 15 years and up to 40 tons per acre after 35 years, depending on the timing and intensity of wind events over that period. Excessive levels of coarse woody debris are likely to elevate the risk of soil heating during subsequent fire events and could inhibit nutrient cycling by diverting microbial populations to the breakdown lignin for an extended period of time.

Long-term Site Productivity

The effects of the consumption of biomass and any associated nutrients on long-term site productivity are difficult to quantify over time. Comparing the estimated amount of individual nutrient consumed by the fire with the estimated annual input of each nutrient gives an indication of the extent to which the fire impacted the nutrient components of site productivity. Narrative discussions on the losses of soil borne nutrients incurred by the fire and subsequent replenishment pathways for each nutrient follow the summary of estimated above ground losses and annual inputs in table 3.7. ***The effects of the No Action alternative on nutrient availability and replenishment as they relate to long-term site productivity are considered to be negligible over the next few decades and minimal as coarse wood levels on the soil surface rise to levels predicted by fuel models after 30 to 40 years.***

Table 3.7 Estimated Above Ground Nutrient Losses within Stand Replacement Mortality Areas and Annual, Post-fire Nutrient Input

Above Ground Nutrient Budgets			
Nutrient	Pre-fire amounts	Post-fire amounts*	Annual input from photosynthesis
carbon	138.4 tons/acre	96.6 tons/acre	.24 tons/acre**
nitrogen	1,356 lbs/acre	546.8 lbs/acre	0.17 lbs/acre
phosphorus	145.7 lbs/acre	61.89 lbs/acre	0.02***

* Amount lost was calculated based on the combustion of the entire vegetative and organic component associated with herbaceous shrubs, wood residues, and surface litter and duff, as well as 60% combustion in weight of the crowns of trees and 20% in weight of the bark component. Site budgets of the primary nutrients contained in the crown, bark, litter and duff, wood residues and shrubs of a fully stocked Ponderosa Pine forest containing 90 ft2/acre of basal area were used as a basis for estimating levels in a representative mixed conifer stand containing 260 ft2/acre of basal area to calculate this loss (Little and Shainsky 1995).
** The annual input of photosynthesized carbon into a fully stocked forestland system (Busse, 1994; Little and Shainsky 1995). Annual input of a post-fire, shrub/grass/forb dominated community is estimated to be at or above these rates when fully stocked (Busse, personal communication). Movement of carbon contained in standing trees to the ground would occur as fire killed trees rotted and were windthrown over the next twenty years.
*** Inputs from new organic matter produced on site would occur over the course of the next few decades that would slowly replenish the above ground amounts lost from the fire. The majority of annual input to the soil system comes from the weathering of parent material and soil in place. Measured concentrations of this nutrient in the soil profile are relatively high and contain upwards of 98% of the total P stored on site (Little and Shainsky 1995).

Carbon - The loss of carbon from the fire was primarily through the consumption of live vegetation, litter and duff on the soil surface, and coarse woody debris. Above ground losses include the consumption of needles and small branches in the standing trees that provided regular input of fine organics to the soil. Total losses of soil borne carbon are difficult to measure but could be approximately 9 tons/acre in soils containing 3 to 4% organic carbon. ***The No Action alternative would not remove any additional carbon from the sites.***

Carbon levels in a forest system are replenished by photosynthetic processes that create new biomass contained in roots and vegetation. The annual input of photosynthesized carbon into a fully stocked forestland system has been measured at 0.24 tons/acre (Busse 1994; Little and Shainsky 1995). The annual photosynthetic input of carbon within a post-fire shrub/grass/forb dominated community would gradually return to this rate over the next few years as the site becomes fully re-vegetated. ***Shrub and herbaceous re-growth is already occurring on site which will contribute carbon through photosynthetic mechanisms at rates comparable to a mature forest community within the next decade*** (Busse, personal communication).

Nitrogen - Total nitrogen on some sites may have been reduced by up to 500 lbs/acre through the consumption of above ground organic material and the volatilization of some inorganic forms of nitrogen (Busse, personal communication; Grier 1975). Quantifying the amount of soil borne nitrogen consumed is very difficult. Many organic forms of nitrogen are converted to inorganic, ammonium forms of nitrogen which are available for plant uptake in the immediate years following the event. This flush of plant available nitrogen following fire events has been widely observed and measured by research (Clark 2001; Deluca 2000). ***The return of vegetation observed during the late summer and fall of 2003 indicates that this nitrogen flush has occurred as a result of the fire.***

Nitrogen replenishment in forestland plant associations occurs through symbiotic-N fixation by bacteria and actinomycetes in the nodules associated with the roots of Ceanothus (snowbrush) and Purshia tridentata (bitterbrush). Nitrogen fixation rates for these shrub species have been measured locally to be 15 to 20 lbs/acre/year and 0 to 2 lbs/acre/year, respectively. Atmospheric deposition of nitrogen also occurs within forestland/shrub systems and has been measured at rates of 1 to 10 pounds/acre/year (Busse, personal communication). ***The return of Ceanothus and other herbaceous vegetation during the late summer and fall of 2003 indicates that there is plant available nitrogen following the fire and that this growth of N-fixing species will begin to contribute nitrogen within the soil profile at or near normal rates in subsequent years.***

Phosphorus - The amount of phosphorus removed from the system during the fire primarily comes from the combustion of shrubs and tree crown components. Total losses from the combustion of surface organics and live vegetation are a very small percentage of the total phosphorus contained in the system because over 98% of this nutrient is stored within the soil profile. Losses of phosphorus from volatilization within the soil profile are difficult to quantify but are likely to have occurred to a greater degree under down logs where a longer duration of higher temperatures were sustained during the fire.

Phosphorus replenishment into the soil system is very slow because it is derived from the weathering processes of soil minerals. The soils within the Davis area are relatively low in phosphorus but are not considered to be phosphorus deficient. Levels have been measured at 50 ppm in the mineral soil A horizons of Mazama pumice and ash located in the Long-Term Productivity Plots on the Deschutes National Forest (Busse, personal communication) and 6,400 to 10,000 pounds/acre in a complete profile of similar soil (Little and Shainsky 1995). ***Levels of phosphorus following the fire would not be considered to be deficient for vegetative growth.***

Sulfur - As with phosphorus, the amounts of sulfur lost from the combustion of organics during the wildfire are relatively small since a very small percentage of the site budget of sulfur is contained in the vegetative component. Losses of this nutrient are primarily from the volatilization of soil organics and nutrients in solution under down logs where high temperatures were sustained for an extended period of time. ***Levels of sulfur following the fire would not be considered to be deficient for vegetative growth.***

The amount of atmospheric input of sulfur into the terrestrial environment varies throughout the world according to concentrations and rainfall. Gaseous forms of sulfur in the atmosphere can be deposited in rainfall or by dry fallout. Estimates of this input into soils of the United States range from 20 pounds/acre/year, as measured in an Indiana soil, up to 200 pound/acre/year closer to industrial point sources (Barber 1984). Estimates for the local area are less than this given the absence of a significant industrial source upwind of the Deschutes and Klamath county areas. Estimated input of oxides of sulfur from local and mobile sources is 1,324 tons/year for Deschutes county or approximately 1.4 lbs/acre/year (L.Caulkin, personal communication**).**

Exchangeable bases (potassium, sodium, calcium and magnesium)

Exchangeable bases are likely to be readily available within the mineral soil following the wildfire event. The volatilization temperatures of the primary exchangeable bases are above 700 degrees C and all four of these nutrients are readily released from the combustion of above-ground biomass (Agee, 1993). The volcanic ash soils present in the fire area have moderate cation exchange capacities and are capable of adsorbing cations of these nutrients contained in the ash of the wildfire and subsequently leached into the soil solution. Soil nutrient samples in Jeffrey Pine forests in the eastern Sierra following fire have documented short-term increases in exchangeable bases (Blank, 1998). The No Action alternative would have no additional short-term effect on these levels and would provide the greatest amount and extent of post-fire coarse wood containing these nutrients for long-term input to the mineral soil.

Alternative B

The effects described for this alternative are applicable for the other action alternatives, which differ primarily in the extent of these effects due to changes in logging systems and acres proposed for commercial salvage. Alternative B would have a variety of direct, indirect, and cumulative effects on the soil resource.

Direct effects to the soil resource are primarily related to alterations of the physical component of the soil through compaction or displacement by machines utilized for harvest and yarding operations. Indirect effects are related to changes in the biotic and chemical components integral to soil productivity as a result of physical alterations to the soil resource and/or changes to the chemical component of the soil resource from the physical removal or treatment of vegetative material during harvest and fuels treatment activities. Cumulative effects are primarily a result of proposed activities occurring in areas where previous activities have incurred varying degrees of disturbance and detrimental impacts to the soil resource.

Physical Components

Approximately 6,355 acres are proposed for salvage logging under this alternative using a variety of ground-based, skyline, and helicopter harvest and yarding systems. Ground-based units would utilize tracked or wheeled harvesters to fell and bunch merchantable trees and either rubber-tired skidders or tracked forwarders to yard this material to the landings. Skyline and helicopter units would have merchantable material hand-felled and yarded via the respective mechanism. Table 3.8 summarizes these harvest systems for the proposed unit acres by 6th field subwatersheds within the project area.

Table 3.8 Alternative B Logging System Unit Acres by Subwatershed

	6th Field Subwatershed (Unit Acres)						
LOGGING SYSTEM	**Odell Creek**	**Davis Creek**	**Middle Crescent**	**Lower Crescent**	**Davis Lake**	**Wickiup**	**Hamner Butte**
Ground	466	22	34	42	1,863	597	757
Skyline	272	0	0	0	340	176	0
Helicopter	91	9	0	0	1,221	23	421
Total Harvest Acres	829	31	34	42	3,424	796	1,178
Fuels Treatment	222	124	53	60	441	389	114

Harvest and Fuels Treatment Infrastructure

Approximately 3,785 unit acres are proposed for ground based harvest and yarding systems. This alternative would also treat a 100 ft corridor along roads 6230, 6240 and 6245 for hazard tree removal where commercial salvage units are not located. Ground-based systems are likely to utilize boom-mounted excavators or harvester forwarders to cut and accumulate trees, and rubber tired grapple skidders or tracked forwarders to yard the material to landings for processing or loading. Past monitoring of single entry harvest units has shown that 15 to 30% of a unit can be detrimentally compacted by ground-based harvest systems depending on the spacing of skid trails, trees per acre removed and the soil conditions at the time of harvest (Deschutes Soil Monitoring, 1995). Additional detrimental conditions can be incurred by post harvest fuels treatments that utilize machinery to pile slash located off of existing skid trails. The hazard tree removal along the four digit roads would be completed with ground-based machinery from the roadways.

Unit acres yarded with skyline or helicopter systems would not commit acreage to skid trails. Skyline systems would create yarding corridors that could see significant gouging and soil displacement during the removal of the large volumes proposed for salvage from these units. Low slope gradients would likely allow for only single end suspension in these units.

Proposed piling and burn treatments to reduce slash levels created from the harvest and fuels activities would include the use of grapples to pile in activity units salvaged with a ground-based system, and underburns, handpiling or lop and scatter methods in units employing skyline or helicopter yarding systems. Machine piling could be implemented on up to 3,785 unit acres and would be primarily limited to skid trails and landings used for commercial harvest and yarding operations. Approximately 60% of the fuel load present after completion of harvest activities would be piled and burned. Treatments could entail single passes of off-trail machine traffic to pile slash located between skid trails if fuel loading was not sufficiently reduced after operations occurred from existing trails.

Direct effects on the Physical Component – Alternative B

Extent of Detrimental Disturbance from Ground-based Harvest and Fuels Treatment Activities

Detrimental conditions measured on the forest for a variety of harvest operations utilizing ground-based harvest systems are primarily in the form of compaction and displacement. Measurements of existing detrimental conditions and predicted, post-harvest conditions are summarized in Appendix B for the action alternatives. Estimations of the extent of these conditions as a result of harvest and yarding activities account for the high volumes (25 to 40 mbf/acre) proposed for removal and the additional treatments necessary to process activity fuels and unmerchantable material ranging from 3 to 14 inches dbh. Both of these factors directly relate to the number of machine trips required to cut and yard material to a landing and subsequent physical disturbance to the soil resource. The extent of detrimental compaction usually coincides directly to the number of skid trails and landings created

within a unit. Additional areas off of this infrastructure could incur detrimental compaction where multiple passes of machine traffic occurs. The extent of detrimental displacement could include areas of single passes by machines where extreme gouging occurs from turning or contouring maneuvers on moderate slopes (Deschutes Soil Monitoring, 1994-2001).

Ground-based logging systems within salvage units with existing impacts of less than 5% are expected to incur detrimental compaction or displacement on 15 to 20% of their unit area from felling, yarding and processing activities. Detrimental compaction requires bulk density increases of 20% or greater over natural, undisturbed levels in ash and pumice soils (FSM 2500, R6 Supplement). Levels exceeding this limit have been measured on ash soils after four or more passes by ground-based tracked and rubber tired machinery used for harvest operations of this type (Deschutes Monitoring). Skid trails, landings and areas of multiple machinery passes without frozen ground or snow cover conditions within the proposed units utilizing ground-based harvesting and forwarding machinery would be considered detrimentally compacted following these activities. Approximately 10 to 15% of these unit areas would be committed to skid trails and landings in order to harvest and yard material, with an additional 5% of the unit areas incurring detrimental conditions from harvest and fuels treatment traffic between skid trails.

Actual spacing of skid trails would be variable across the units, dependent primarily on the topography and the distribution of the trees intended for harvest within the unit. Based on an average disturbed width of 12 feet, parallel skid trail spacing of 100 feet would commit 11% of a ground-based activity unit to a detrimental condition. Skid trail patterns are generally more dendritic due to topography and landing locations and average closer to 75 foot spacing or 14% of the unit area. Skid trail spacing of greater than 60 feet would also entail the off-trail travel of machine harvesters to reach material more than 20 feet from the trail.

The physical impacts incurred by the off-trail machine traffic is generally measured to be detrimental on areas where multiple passes have occurred over soil that is not frozen greater than 6 inches in depth or is devoid of sufficiently deep or firm snow cover to mitigate ground pressures. Off-trail travel of harvest and activity fuels treatment traffic without these conditions could incur impacts on unit area between skid trails spaced at 60 feet or greater. Forest averages for landings within the activity units removing comparable volumes proposed in this salvage are approximately one landing (100 ft. by 100 ft.) for 10 to 14 acres of harvest acreage or 2% of the activity area.

Effects of Detrimental Disturbance

Compaction in coarse textured soils on the forest has been determined to occur primarily due to vibrational mechanisms (Chitwood, personal communication). Detrimentally compacted soils may reduce tree growth and soil productivity by limiting root establishment and growth of trees, and reducing mycorrhizal microbial populations integral to nutrient availability and uptake. Water infiltration can also be reduced on these areas due to reduced porosity or higher soil moisture levels at the time of summer thunderstorm events as a result of reduced vegetative evapotranspiration. Soil moisture levels above those present in less disturbed soils have been observed on skid trails in mid-summer due to lowered transpiration rates from the lack of shrub and herbaceous re-growth. Activity areas in which the detrimental soil conditions exceeded 20% of their area may have lowered site productivity as a result of these altered soil functions.

Displacement of soil occurs primarily when ground-based machinery pivots quickly in loose mineral soil on a slope. Detrimental displacement requires the removal of greater than 50% of the mineral A horizon over an area of 100 square feet or greater (FSM 2500, R6 Supplement). Although past monitoring of harvest activities has found that detrimental displacement occurs infrequently (Deschutes Soil Monitoring), the combination of exposed mineral soil, limited slash on the soil surface and moderate slopes raises the risk of displacement from machine traffic off of established skid trails and landings within unit areas proposed for ground-based harvest and yarding operations. ***Detrimental displacement would be expected to occur over less than 5% of the unit areas.***

Skyline and Helicopter Systems

Units with skyline and helicopter harvest systems are expected to incur lower levels of detrimental conditions than those estimated for units utilizing ground-based felling and yarding machinery. Average distances between skyline corridors are approximately 140 ft, based on a maximum 70 ft lateral yarding distance. Average width of the skyline corridors could approximate 15 feet in width. Corridors of this width and spacing would cover

approximately 15% of the unit area utilizing this system. Landings required to handle yarded material are estimated to be up to 5% of the unit area harvested.

Units would be expected to meet soil standards and guidelines for the soil resource following harvest and fuels treatment activities. Detrimental disturbance levels for skyline units are estimated to be approximately 10% of the unit area for salvage prescriptions, with disturbance in the form of compaction and displacement on areas committed for landings and variable amounts of displacement within skyline corridors. Although material yarded to these landings would be hot loaded onto trucks in order to keep landing sizes to a minimum, the yarding of tops attached to the last log would require slightly larger landings for processing this material. Yarded material would be pulled with only one-end log suspension due to the relatively shallow slopes present. Harvested trees in skyline units would be hand-felled.

Helicopter units would be expected to incur the lowest levels of soil disturbance from operations. Harvested trees would be hand felled and yarding would involve choker sets on logs lifted by the helicopters. Landings needed to process material with tops attached would also need to be slightly larger and would generally utilize old landings or road beds near or adjacent to cutting areas. Some clearing of standing material up or down slope of the road bed landing areas would occur to create safe and operable conditions. Landings required to handle yarded material with tops attached are estimated to be up to 5% of the unit area harvested. Detrimental soil disturbance within the units is expected to be minimal in extent, with isolated areas of gouging and displacement as felled trees are initially lifted from the ground.

Temporary Roads

Approximately 11.4 miles of temporary road would be utilized under this alternative to access landings within ground-based activity units. Most of these roads would utilize existing skid trails used for harvest and yarding operations and would involve some level of improvement, primarily widening with a dozer blade. Very little, if any, cut and fill disturbance would be required for the development of these road surfaces. An estimated 21 acres would incur temporary detrimental compaction of the soil resource as a result of this use. ***Temporary roads would be subsoiled where possible, which would return hydrologic function to these acres. The loss and/or mixing of surface mineral A horizon material on these areas would be expected to slow the return of vegetative cover on these sites, unless seedlings were planted following operations.***

Detrimental acres following activities proposed under Alternative B are summarized by subwatershed in table 3.9. Appendix B (table B-1) summarizes existing and estimated detrimental conditions for all activity.

Table 3.9 Alternative B Predicted Detrimental Acres from Proposed Harvest Activities

	6th Field Subwatershed Harvest and Predicted Detrimental Acres			
	Odell Creek	**Davis Lake**	**Wickiup**	**Hamner Butte**
Total Subwatershed Acres	13,830 ac	22,505 ac	26,965 ac	13,360 ac
Proposed Harvest Acres	1,051 ac	3,865 ac	1,185 ac	1,292 ac
% Subwatershed proposed Harvest	8%	17%	4%	10%
% Subwatershed Ground Harvest	5%	10%	4%	7%
Detrimental acres Ground Harvest*	138 ac	461 ac	197 ac	174 ac
Detrimental acres from other Harvest Systems**	36 ac	156 ac	20 ac	42 ac
% Subwatershed detrimental***	1.2%	2.7 %	0.8 %	1.6 %

* Detrimental acres Ground Harvest are calculated as 20% of the proposed Ground-based Harvest unit acres utilizing machine feller-bunchers and skidders or forwarders plus 20% of the Fuels treatment only units that are likely to utilize designated operating trails and grapple machine piling.

** Detrimental acres from other Harvest Systems are calculated as a maximum amount of 10% of unit acreage on Skyline and Helicopter units.

*** % Subwatershed detrimental summarizes additional acres predicted to be detrimental following proposed harvest, fuels and subsoiling treatments for all unit acres.

Erosion Risks

Erosion risks under Alternative B would increase slightly when compared to the No Action alternative due to the physical disturbance of surface vegetation and the compaction of soil on skid trails and landings within proposed activity units. This Alternative would disturb the largest amount of area of all the alternatives analyzed in this EIS. Approximately 17% of the Davis Lake subwatershed area would have commercial salvage or small diameter fuels treatment activities capable of disturbing established vegetation and compacting or displacing the soil resource. An estimated 2.7% of the Davis Lake subwatershed area could be compacted or displaced by these activities, primarily as skid trails and landings for yarding operations (table 3.9).

Disturbance as a result of proposed activities would slightly increase the amount of mineral soil susceptible to erosion. Compacted areas are capable of creating overland flows during storm events that could transport soil particles, while the disturbance of ground vegetation established since the fire would expose more mineral soil and increase direct rain drop impacts. Although compacted skid trails and landings could transport overland flows and detached soil particles, the gentle slopes within ground-based units would limit the extent of these flows. ***Compaction and vegetative disturbance from proposed activities are unlikely to significantly increase erosion risks when compared to the loss of live vegetative cover and the amount of soil exposed by the fire.*** Proposed activities would also increase the surface roughness within activity units as activity fuels were created by salvage operations.

Effective Ground Cover

LRMP SL-6 states that effective ground cover should be met within the first two years after an activity is completed for the range of low to severe surface soil erosion potentials. The majority of soils within the project have low potentials for surface soil erosion and require 20-30% minimum effective ground cover the 1st year after management activity and 31-45% after the 2nd year in order to meet LRMP SL-6. Four soil types within the project area have moderate or moderate to high potentials and require slightly higher percentages of aerial cover. Effective ground cover is defined as including all living or dead herbaceous or woody materials and rock fragments greater than three-fourths of an inch in diameter in contact with the ground surface. This includes tree or shrub seedlings, grass, forbs, litter, woody biomass, chips and so forth (Deschutes LRMP, Table 4-30, footnote 3).

The effect of proposed salvage operations on existing effective cover values would be two fold. The use of ground-based machinery would crush or uproot established vegetation on areas implemented as skid trails and landings, the extent of which, combined with off trail passes of a feller/buncher excavator, is generally between 20 and 40% of an activity area. Skid trails and landings would be completely void of vegetation following harvest and yarding and average 15% of a unit, while off-trail tracks would generally flatten existing vegetation that is often capable of re-establishing itself.

Changes to effective cover values from the implementation use of landings and skid trails is estimated to be a fraction of the 15% of an activity unit that their aerial extent covers. Only a portion of areas disturbed would have vegetative cover prior to proposed activities, estimated to range from 30 to 80% by the time proposed activities occur. Predicted reductions in effective cover from disturbance on skid trails and landings are approximately 8% within activity areas containing 50% effective ground cover value at the time of entry. This would leave values of greater than 40% on these sites after proposed activities were implemented. Organic, woody branches and smaller boles moved to the ground during the felling and yarding of material would offset this reduction to some degree.

Observations following ground based salvage in the Lower Jack Contract Modification units within the B&B complex fire estimate cover values exceeding 50% on a very high productivity site and 30% on a moderate productivity site. The discrepancy in cover between sites is primarily a result of the herbaceous species composition

of the site, with a thick cover of Epilobium on the higher productivity site and a thinner cover of ceanothus seedlings and Bracken fern on the moderate productivity site.

Proposed activity areas located on SRI soil types 59, 68, 84 or 9Z that have moderate or moderate to high surface soil erosion potentials would implement hand-felling and either helicopter or skyline yarding to remove material. The disturbance of effective ground cover from these systems would be less than that predicted for ground-based activities and would also be expected to meet SL-6 within two years following the implementation of proposed activities.

Disturbance resulting from the implementation of ground based harvest and yarding systems is not expected to slow the growth or overall recovery of vegetation established on the site over the years subsequent to salvage and fuels treatment activities. Although vegetative recovery would be very slow to occur on skid trails and landings that were not subsoiled, recovery between skid trails should occur at a rate capable of providing effective cover within a few years. Cover values of shrubs and biomass production on salvaged areas in the Lone Pine fire after five years were not statistically significantly different than un-salvaged controls. These areas also had additional cover provided by planted and naturally regenerated conifers (**Mallaby, 2000**). Salvaged units that utilized ground-based harvest systems within the McKay and Pringle fires on the Bend/Ft. Rock district are observed to have significant cover values provided primarily by ceanothus shrubs and various perennials within five years after salvage activities occurred. Activity areas proposed for harvest would also be planted with seedlings that would provide additional cover capable of reducing raindrop impacts on exposed mineral soil. ***Based on the observations of the Lower Jack, McKay and Pringle salvage unit on the Deschutes National Forest, and information from the Lone Pine study, effective cover values on acres proposed for treatment would be of sufficient levels to meet SL-6 within the first two years following implementation of activities.***

Sediment Delivery

Sediment delivery to streams as a result of soil disturbance from proposed activities is not expected to increase significantly. Disturbance from commercial salvage activities within the 480 ft sediment delivery zone previously identified in this report would occur within activity units 15, 20 and 120, all of which are adjacent to Davis Lake. No activities would take place within 300 feet of the lakeshore, however. No commercial activities are proposed within the 480 ft delivery zone along Odell or Ranger Creeks and none of the upland areas contained within proposed activity units directly feeds into intermittent drainages or roads that can be considered hydrologically connected to these perennial streams. ***Predicted increases in sediment delivery to streams as a result of these activities would be negligible when compared to those resulting from the fire.***

Chemical and Biological Components

Effects to the chemical and biotic components of the soil resource relate indirectly to changes in the physical component of the soil resource and to any alterations of the ratio of soil borne carbon and nitrogen present on site. The removal of organic material present in tree boles would also directly affect the chemical component by altering the total nutrient budget on site.

Direct Effects – Alternative B

Although compaction of the soil resource can physically reduce or inhibit biotic populations within the soil profile, these indirect effects are likely to be localized to areas committed to landings and skid trails and should not be detrimental to overall populations and site productivity if limited to less than 20% of the activity area.

Changes to above ground carbon and nitrogen budgets for this discussion are based on the proposed removal of 80% of merchantable trees from proposed salvage units and the treatment of 60% of the 3 to 12" nonmerchantable material on site. Although the removal of tree boles would reduce the amount of carbon and nitrogen on site, there would still be substantial amounts present within the remaining snags, down wood and non-merchantable size classes. Skyline and helicopter units are likely to have lower amounts of these nutrients removed with "leave tops attached" prescriptions than ground-based units that were whole tree yarded. Table 3.10 summarizes the estimated calculations of the amounts of nutrients that would be lost from harvest removal or fuels treatments within proposed units under Alternative B. Assumptions used for calculating changes in nutrient budgets are included in footnotes to the table.

Table 3.10 Alternative B Nutrient Removal from Proposed Harvest within Stand Replacement Activity Units

Estimated Above Ground Nutrient Levels Remaining or Removed Per Activity (weight/acre)								
Nutrient	Pre-fire amounts onsite @ 260 ft2/acre of basal area*	Post-fire amounts onsite**	Amount lost with l.t.a. yarding ***	Amount lost with no tops yarding ****	Amount contained in bolewood of tops	Post-fire amount contained in unmerchantable 3 to 12" dbh material (90 ft2/acre of basal area)	Amount remaining in 3 to 12" material after fuels treatment	Amount remaining after harvest (lta) and fuels treatments
carbon	138.4 tons/acre	96.6 tons/acre	21.08 tons/acre	20.94 tons/acre	0.14 tons/acre	22.41 tons/acre	8.96 tons/acre	62.1 tons/acre
nitrogen	1,356 lbs/acre	546.8 lbs/acre	96.0 lbs/acre	106.25 lbs/acre	0.45 lbs/acre	111.12 lbs/acre	44.45 lbs/acre	384.1 lbs/acre
phosphorus	145.7 lbs/acre	61.89 lbs/acre	14.39 lbs/acre	15.73 lbs/acre	.07 lbs/acre	16.2 lbs/acre	6.48 lbs/acre	37.8 lbs/acre

* Pre-fire levels of above ground nutrients include that stored in all tree components, shrubs, forest floor litter and duff, and wood residues on site. Numbers were converted from those destructively sampled for a second growth Ponderosa Pine stand averaging 112 trees per acre and a basal area of 90.2 ft2/acre (Little and Shainsky 1995) to reflect a mixed conifer dry stand averaging 70 trees per acre >12" dbh and 750 trees per acre <12" dbh totaling a basal area of 260 ft2/acre.

**Assumes stand replacement conditions in which above ground nutrient amounts consumed by the fire were calculated as the loss of 60% of the crown weight and 20% of the bark weight of nutrients contained in pre-fire tree volumes, 30% of residue weight, and 100% of shrub and forest floor litter and duff weights estimated to be on site.

*** Maximum amounts lost from harvest operations utilizing "leave tops attached" fuels treatments. Amounts lost on acres proposed for salvage are based on the physical removal of 80% of merchantable trees >12" dbh from within activity units. Totals calculated include 80% of the nutrient budget contained in bolewood, plus 35% of the crown by weight (50% considered to be de-limbed or broken off during yarding) and 70% of the bark by weight (10% considered to slough off during yarding operations) contained in the same amount of bolewood. Helicopter and skyline units would remove lesser amounts due to the lopping of most limbs before yarding operations.

Site budgets of the primary nutrients contained in the crown, bolewood and bark of a fully stocked, live Ponderosa Pine forest with 112 trees per acre (90.2 ft2/acre of basal area) have been measured to be 24 T/acre C, 175 lb/acre N, 24 lb/acre P and approximately 10 lb/acre S (Little and Shainsky 1995). Site budgets of these nutrients were proportionally adjusted to represent the removal of approximately 152 ft2/acre of basal area for this project area. Primary nutrient totals contained in this material pre-fire would be approximately 40.3 T/acre C 294 lb/acre N, 40 lb/acre P and approximately 17 lb/acre S. Post-fire amounts contained in this material are approximately 32 T/acre C, 175 lb/acre N, 25 lb/acre P and 10 lb/acre S.

**** Maximum amounts lost from Skyline and Helicopter units if tops were removed before yarding. Amounts lost on acres proposed for salvage are based on the physical removal of 80% of merchantable trees >12" dbh from within activity units. Totals calculated subtract the nutrients contained in the bolewood of tops assumed to be 25 feet in length above a 6 inch diameter ,which calculate to be 0.21 metric tonnes per top (Little and Shainsky 1995).

Above–ground Nutrient Pools

Acres that burned as Stand Replacement mortality had an estimated 30% of above ground carbon and 60% of above ground nitrogen stored in live vegetation and organic residues consumed by the fire. Proposed harvest and fuels treatment prescriptions could remove up to 80% of the remaining merchantable tree boles on site and 60% of the remaining unmerchantable material in the 3 to 12" dbh size class. An estimated 62.1 T/acre of carbon and 384.1 lb/acre of nitrogen would be left on site following harvest and fuels treatments operations in stands currently containing 260 ft2/acre of basal area. These nutrients would be stored in snags, coarse wood, limbs lopped or broken off of felled and yarded merchantable material, and untreated 3 to 12" fuels. These levels are approximately 64% and 70%, respectively, of the carbon and nitrogen currently stored above ground on these sites following the fire.

It is noteworthy that the consumption of crown needles and surface litter and duff during the fire has removed the greatest amount of mineralizable forms of nutrients from these sites. Although above ground levels of nutrient loss were relatively high from the fire, additional loss as a result of commercial harvest and/or fuels treatments would not reduce levels to negligible amounts for any of the primary nutrients. The above ground storage of nitrogen and phosphorus, especially that contained in tree bolewood, is a small percentage of the total amounts of these nutrients stored above and below ground (Little and Shainsky 1995). Nutrients contained in bolewood are longer-term

storage sinks of the primary nutrients in the system to be released slowly through the decay of down woody material. This storage sink would be maintained in the form of snags and coarse wood left on site. ***Prescriptions for snag and coarse wood levels and the amounts of finer, 100 hr fuels contained in the 3 to 12", non-merchantable material left untreated would leave sufficient levels of nutrient storage on site for microbial conversion to plant-available forms in the soil.*** Vegetative re-growth over the next decade would primarily utilize nutrients currently available or stored in the soil profile until inputs of these nutrients from atmospheric deposition and vegetative decomposition gradually returned concentrations of these nutrients to pre-fire levels.

Fuel models were used to predict slash accumulations on the soil surface and any subsequent needs for fuels piling within all proposed units would depend on the distribution and amount of material following harvest and yarding operations. Predicted fuels levels following proposed harvest and yarding activities under Alternative B range from 30 to 40% of the pre-fire above ground biomass, although the 1 and 10 hr fuel classes would not be well represented (Owens 2003). Finer organic material in the 1 and 10 hr fuels classes would be contributed to the soil surface sooner under all action alternatives when compared to the no-action alternative as a result of de-limbing, breakage and fuels treatments of the 3 to 12"dbh material. ***Organic input to the soil surface within activity units salvaged and replanted would occur at a faster rate when compared to the no-action alternative.***

Below-ground Nutrient Pools

Speculated losses and transformations of below-ground nutrient pools were discussed under the Existing Condition and No-action alternative sections of the Soils section. Although the loss of nitrogen and carbon near the surface likely occurred through volatilization and consumption mechanisms, there has also been an immediate flush of nitrogen in the soil system as a result of mineralizing processes during and after the fire event. Additional contributions of these nutrients would be provided by the decomposition of fine and coarse roots associated with vegetation consumed or killed by the fire.

Soil levels of phosphorus and nitrogen are far greater than those stored in above ground material and should provide sufficient amounts for site productivity to be maintained until vegetative regrowth of perennial shrubs, planted conifers and herbaceous forbs and grasses begins to provide organic input on the soil surface and into the mineral soil A horizon. Much of the material remaining on site after proposed harvest and fuels treatment activities would be pushed to the ground and would be a source of mineralizable nutrients and microbial habitat during this period. ***As a result, below ground nutrient pools would not be negatively affected by the removal of above ground material and would be enhanced in many cases by the movement of organic material to the soil surface.***

Cumulative Effects on the Chemical and Biological Component – Alternative B

Long-term Site Productivity

Above ground site budgets of both carbon and nitrogen within activity units proposed under the action alternatives would be reduced from post-fire levels by approximately 55% and 72%, respectively. Although the loss of soil carbon from the fire was variable, a slightly lower C:N ratio may be present during the immediate growing seasons when the short term, post-fire flush of inorganic nitrogen is taken into account. Slight reductions in soil borne C:N ratios deduced from the post-fire flush of available ammonium nitrogen and the combustion of some carbon within the surface A horizon would tend to focus microbial activity associated with lignin consumption toward nutrient cycling and uptake during this time. Although the addition of slash on the soil surface from proposed activities could divert some microbial activity on site toward the breakdown of lignin, the functional, soil borne C:N ratio on site is not likely to be altered. ***The addition of organics containing carbon and nitrogen on the soil surface is also likely to return the soil borne C:N ratios to pre-fire levels sooner than under alternative A.***

The chemical pathways and input rates of the primary nutrients described under Alternative B are applicable for Alternatives C, D and E. Planting of acres proposed for salvage would jump start the return of fine organic litter inputs from trees over Alternative A by up to 20 years, depending on the rate and density of natural regeneration that occurs over the next few years. Needles of seedlings planted in activity units would provide inputs of this carbon and other nutrients to the soil surface over subsequent years. Any changes in the soil borne C:N ratio are unlikely to occur at levels significant enough limit the productivity of the site.

Coarse woody debris - Direction on the forest for the Action Alternatives is driven primarily by the Northwest Forest Plan Record of Decision for coarse woody debris and the Late Successional Reserve Assessment completed for the Davis LSR. Table 3-2 in the Davis LSR Assessment provides suitable habitat conditions by plant association and includes recommended coarse woody debris levels to maintain a sustainable habitat containing a suitable supply for the future. Recommended levels range from 12 to 24 tons/acre within the dry ponderosa pine and mixed conifer plant association groups. The NWFP ROD requires that coarse wood currently on the ground within Matrix and LSR stands remain intact and that these areas be managed for a renewable supply for the future.

Current levels of coarse woody debris measured within dry ponderosa and mixed conifer sites range between 3 and 20 tons/acre (Owens, 2004). Although some areas are currently below the recommended levels of 7 to 14 tons/acre for optimum ectomychorrizal activity and associated soil productivity (Graham et al.1994; Brown et. al. 2003), variable amounts of currently standing, non-merchantable coarse wood in the 3 to 12" size class would be immediately contributed to the soil surface during salvage harvest and yarding operations. Additional amounts of coarse wood >12" dbh" would be expected to accumulate on the soil surface over time as snags left standing began to windthrow to the ground. ***In total, the levels of coarse wood in all size classes on the soil surface following proposed activities would be sufficient to maintain soil productivity and provide microbial habitat, nutrient storage and moisture retention on site.***

Alternatives C, D and E

Direct and cumulative effects to the physical, chemical and biological components of the soil resource would be similar for each of the action alternatives as those described for alternative B. The primary differences would be in the extent, and to some degree, the location, of these effects as a result of changes to logging systems or the reduction in the number of acres proposed for activities.

Alternative C

Alternative C would treat the same number of commercial salvage acres as Alternative B but would reduce physical impacts to the soil resource by changing 762 unit acres of ground-based harvest and 610 acres of skyline harvest to helicopter harvest systems. This would reduce the amount of detrimental soil disturbance within these activity units by up to 15% or 114 total acres within the units converted from ground-based harvest and up to 10% or 61 acres within units converted from skyline units. The change from ground-based to helicopter harvest systems in these unit areas would reduce the need for subsoiling by up to 29 acres in order to meet soil standards and guidelines for detrimental disturbance.

The activity units in which helicopter systems would be substituted for ground-based systems are located within the Davis Lake and Wickiup subwatersheds. These changes would reduce the amount of ground-based harvest activity within these subwatersheds by 1% and 2% of their respective areas. Total detrimental soil disturbance within these subwatersheds could be reduced by up to 40 and 74 acres, respectively, in these two subwatersheds. The specific units altered are located at least a mile from either Odell Creek or Davis Lake and would not be expected to contribute sediment to these waterbodies, regardless of the implemented harvest and yarding system.

The activity units in which helicopter systems would be substituted for skyline systems are located primarily within the Davis Lake and Wickiup subwatersheds. Approximately 100 unit acres are located within the Odell Creek subwatershed. Reduced detrimental impacts on up to 15 acres in the Davis Lake and 35 acres in the Wickiup subwatersheds could result when compared to alternative B. ***Alternative C would have a lower amount of total detrimental disturbance to the soil resource than Alternative B and would require approximately 29 fewer acres of subsoiling to meet standard and guidelines.***

The same number of fuels treatment acres are proposed under this alternative as under alternative B. Effects to the soil resource under this alternative would be the same as those described for alternative B.

Alternative D

Alternative D proposes to commercially salvage a total of 1,045 acres, approximately 850 acres using ground-based tractor systems and 195 acres using skyline systems. The majority of commercial salvage activity units are located on matrix lands within the Wickiup subwatershed. When compared to Alternatives B and C, this alternative would greatly reduce the extent of soil disturbance from commercial salvage operations by salvaging 5,110 fewer total acres, and 2,931 fewer acres using ground-based harvest systems. ***Alternative D would detrimentally disturb the least amount of total acreage of any of the action alternatives.***

When compared to alternative E, total soil disturbance from commercial salvage operations would be approximately 33% less in total acreage under this alternative, assuming an average of 20% detrimental disturbance in ground-based units and 10% detrimental damage in helicopter units included in alternative E. Disturbance under this alternative would be primarily on upland soils located in the Wickiup subwatershed at least a half a mile from perennial streams or lakes.

This alternative would also treat 1,750 acres of small diameter fuels in Matrix and LSR land allocations. The 300 additional acres of fuels treatments include a 600 ft corridor along both sides of road 46. These acres are included as commercial salvage acres under the other action alternatives. Total detrimental impact within these 300 acres would be slightly lower than under the commercial salvage treatments proposed for Alternatives B and C. Small diameter fuels treatment units are expected to have variable levels of soil disturbance ranging from 10 to 20% of the respective activity unit area. Much of the work is expected to be accomplished by hand versus mechanized equipment.

This alternative would also treat a 100 ft corridor along roads 6230, 6240 and 6245 for hazard tree removal. The 9 miles of frontage along these roads equates to approximately 24 acres of treated area. Some of these areas are included in activity units proposed under Alternatives B and C. Ground-based harvest and yarding traffic would occur on the roadway beds and existing areas of impact within the 100 ft treatment corridor and are expected to detrimentally impact less than 5% of the acreage area.

Alternative E

Alternative E would commercially salvage approximately 3,290 activity unit acres utilizing hand-felling and helicopter yarding to remove material. Proposed units are located in the Wickiup, Davis Lake and Odell Creek subwatersheds. The greater number of commercial salvage activity units included in this alternative when compared to alternative D could result in more total soil disturbance. However**,** since all commercial salvage would utilize helicopter systems under this alternative***, detrimental disturbance to the soil resource within activity units would be the lowest on a per acre basis for this Alternative when compared to any of the action Alternatives.*** No subsoiling would be necessary to meet soil standards and guidelines within treatment units utilizing hand-felling and helicopter yarding.

This alternative also proposes to enter 1,450 acres for small diameter fuels treatments using ground-based operations as described for the alternatives B and C. Hazard tree removal would also occur using ground-based operations on approximately 24 acres along the 9 miles of roads 6230, 6240 and 6245 within the fire boundary as described for alternative D.

Effects Common to all Alternatives

Cumulative Effects on the Physical Component (Common to All)

The presence of existing detrimental soil disturbance in some proposed activity units could cause cumulative effects in excess of Regional Standards and Guidelines in some areas. Activity units with existing detrimental disturbance are listed in the unit summary table B-1 in Appendix B. The cumulative effects from activities proposed under this EIS, past harvest management actions, fire suppression activities, and reasonably foreseeable future actions could incur detrimental soil disturbance exceeding 20% of the activity area within an estimated 20 of 110 proposed activity units under Alternative B. An estimated 69 acres of activity units would need to be subsoiled in order to reduce detrimental conditions and meet the Regional Standards and Guidelines.

Subsoiling

Subsoiling of compacted areas utilizing a self drafting, winged subsoiler would occur in all action alternatives within proposed units having greater than 20% of their surface area in detrimental compaction following proposed activities. Predicted unit acres requiring subsoiling to meet Standards and Guidelines are 69 acres for Alternative B, 46 acres for Alternative C, and 19 acres for Alternative D. No subsoiling would be needed under Alternative E. Unit estimates for Alternatives B, C and D are included in Appendix table B-1.

Subsoiling directly fractures compacted soil particles and increases macro pore space within the soil profile, both of which contribute to increased water infiltration and enhanced vegetative root development. Although subsoiling does not completely return these areas to pre-impact conditions, it does significantly rectify physical properties to a condition where other soil processes can recover on site. Subsoiling is very effective in reducing soil strengths incurred by the compression and vibration effects of machine traffic. Soil probes taken before and after subsoiling operations show reductions to or below natural levels after a single pass of the implement. Soil conditions following subsoiling can be very fluffed in nature but are observed to return to natural bulk density levels after a year or two of physical settling and moisture percolation through the soil profile (Deschutes Soil Monitoring, 1995).

Vegetation on skid trails following harvest and fuels treatments is generally limited in size and extent due to physical crushing and uprooting. The recovery of this component is primarily affected by a severely compacted rooting zone that is mitigated by this process. Although effects from the displacement or mixing of the mineral surface soil are not completely offset by this operation, the surface mineral component that was compressed into the subsurface horizon would have natural macro pore space returned to the profile providing conditions more conducive to the re-establishment and productive growth of native herbaceous perennials, shrubs and conifers. These areas would subsequently start to receive organic input from the vegetation established on and immediately adjacent to these areas over the following years.

The recovery of soil functions following subsoiling are also influenced by soil biota within the mineral or organic components of the soil. The effects of subsoiling on soil biota were researched in a study of subsoiled skid trails in an area of the Metolius Basin on the Sisters district of the Deschutes National Forest. The composition of soil biota populations and distributions in a compacted soil profile was shown to swing back towards pre-impact conditions after subsoiling of skid trails (Moldenke 1998).

Fuels Treatments

Approximately 1,450 acres are proposed as fuel treatment only units within the project boundary. Standing, non-merchantable material ranging from 3 to 12” dbh would be either hand or machine felled within these units utilizing hand crews or a small tracked Bobcat to shear this material to the ground. Machine grapple piling of this material could occur from existing or designated skid trails, with hand piling of material located out of reach from these trails. Effects incurred on the soil resources would be expected to include detrimental compaction underneath areas of multiple passes by machinery off of established skid trails. Designated trails used for cutting and piling would be expected to have variable levels of compaction and displacement following operations. Total detrimental disturbance would be expected to be less than 20% of the total unit area based on observations of similar fuels treatment operations on the Crescent District implemented over the last five years. Disturbance within these units was calculated to be a maximum of 20% for summaries of detrimental disturbance included in table 3.9.

Fuels treatment activities would also occur within harvest units deemed to have an excess of fuel loading in the 3 to 12” size class after commercial operations were completed. Ground-based harvest units could have grapple pile machinery operating from skid trails and landings created by commercial harvest activities. Hand piling and lop and scatter methods for treating material out of reach from designated skid trails would be utilized in some units and would not create additional physical impacts to the soil resource.

Slash piled within the units would likely be jackpot burned following a period of curing. The burning of slash piles has the potential to volatilize nutrients and soil organisms contained in the soil beneath them. Temperatures exceeding 200 degrees C have been measured 2-5 cm below the soil surface for greater than 4 hours during active pile burns, while soil pH levels were shown to increase dramatically for 0-2.5 cm and 2.5-10 cm soil horizons following these burns (Sheay 1993). Measured soil nitrogen concentrations in these horizons were not reduced due to the downward distillation of organic N from the burn piles and the possible oxidation of N from roots in the top horizons. Few studies have monitored the long-term recovery of soil underneath pile burns.

Pile burning often discolors the mineral soil below them due to the oxidation of iron. This reflects temperatures in excess of 300 degrees C, a level far exceeding volatilization temperatures for some nutrients and organic matter, and one capable of leaving these areas depleted in these components for a number of years. Depending on the amount of slash generated from the harvest operations, the amount of area affected by pile burning would vary from unit to unit but generally average less than 2% of the unit areas. Most piled areas would occur on existing skid trails and landings.

Fire Suppression Dozer and Hand lines

The 55 acres of the soil resource exposed for dozer lines that were not previously a system road were observed to have variable conditions of displacement along their extent, conservatively averaging detrimental conditions on 50% of their surface area. Areas of displaced surface mineral soil not fully replaced or covered by suppression rehabilitation operations would accumulate organic litter from trees adjacent to the lines and from shrubs, forbs, grasses and seedlings that established on the lines in successive years. Productivity on these sites will be somewhat reduced when compared to undisturbed or burned conditions, although vegetation will gradually repopulate these lines over time.

Erosion risks associated with dozer lines are only slightly elevated over the next few years until live vegetation returns to levels capable of reducing raindrop impact energies on exposed mineral soil. The current roughness of the lines provided by the replaced trees and brush would function to slow overland flow energies and limit erosion of exposed mineral soil during low intensity rainfall events and annual snowmelts. Rain on snow or 100 year recurrence interval events would be more likely to erode sections of these lines until they became fully re-vegetated over time.

Handlines constructed during fire suppression activities have had waterbars constructed to reduce overland flow energies and dissipate accumulated flows off of their tread. Rehabilitated lines are likely to accumulate vegetative cover over the next few years at slightly reduced rates when compared to adjacent acres within the burn perimeter that have less compaction and fresh ash on the surface.

Retardant Applications

The effects of retardant chemicals on soil chemistry and water resources depends primarily on their heat induced transformations from the fire, soil characteristics such as organic matter content and Cation Exchange Capacity (CEC), and leaching pathways involved in the system. The majority of retardant dropped within the project area was likely heated to some degree by the fire and altered as described in the retardant transformation discussion included in the existing condition section of this report. Soil organic matter is generally below 4% in this area and the CEC of these soils is moderate. The permeability of the soils is rapid and somewhat conducive to leaching mechanisms that could carry by-products into subsurface flows that could reach Davis Lake or well bottoms drilled at East and West Davis campgrounds. The amount and extent of effects described here are applicable for all alternatives under this analysis.

Based on airtanker records of 12 drops during Davis fire suppression activities and average concentrations of nitrogen, phosphorous and sulfur within the retardant, a total of 2,861 lbs N, 792 lbs P and 2,785 lbs S was applied within or near the fire perimeter from retardant drops. The input of nutrients from retardant applied at recommended rates of 1.5 liters/square meter (CSIRO 2000) would be an estimated 337 kg/ha (300lbs/acre) of nitrogen, 94 kg/ha (83 lbs/acre) of phosphorous and 328 kg/ha (292 lbs/acre) of sulfur over a maximum of 10 acres, assuming no overlap of drops. Concentrations are likely to be lower than this on the soil surface since the retardant would have come to rest on the crowns of trees, herbaceous understory vegetation and organic residues of all fuel classes on the ground. Much of what was applied was likely heated or eventually combusted, depending on the fire behavior or persistence at the time, although some drops occurred away from the primary fire edge and may not have been heated or completely burned over.

Initial accumulations and movement of individual nutrients and compounds in their heated or unheated forms is primarily determined by the timing and duration of precipitation events capable of dissolving retardant residues following the fire. The protocol for retardant application recommends that retardant is not applied within 300 ft of surface waters, although one tanker drop load may have crossed the perennial reach of Odell Creek and one across

the ephemeral/intermittent drainage located to the southeast of Odell Creek that flows into Davis Lake. Field reconnaissance for consultation of fire suppression activities with U.S. Fish and Wildlife did not reveal evidence of residues on adjacent riparian vegetation or fish mortality along the perennial stream reach (Powers 2003). The majority of retardant was applied to upland locations far enough from channels where a very low percentage could contribute to stream concentrations as a result of overland flow mechanisms.

Residues remaining on the surface of organic matter or mineral soil are likely to be dissolved in moisture derived from rainfall and snowmelt and subsequently infiltrated into the soil profile. Rainfall from thunderstorms in August of 2003 was measured to be 0.32 inches and may have set dissolution and infiltration processes in motion. Rain events capable of producing significant overland flows and associated surface erosion have not occurred since the fire.

Further movement through the soil profile of individual nutrients contained in the residues are possible as follows:

1) Residual amounts of sulfuric and phosphoric acids from the retardant not volatilized during the fire are likely to have combined with cations produced by partial combustion of ground and vegetative fuels and then percolated into the soil matrix. Products derived from phosphates that reach the soil matrix are readily adsorbed and fixed to mineral and organic exchange sites in these soils. Products derived from sulfates are more likely to be leached into the groundwater.
2) Residual ammonium nitrogen not taken up by plant roots can be nitrified into nitrate products susceptible to leaching through the soil profile and into groundwater. Inputs of nitrates into the groundwater system would decrease over subsequent growing seasons as vegetative uptake of available nitrogen on site increased toward pre-fire levels (CSIRO 2000).

The proximity of retardant to stream courses would determine whether residues dissolved in concentrated precipitation or present on mineral soil particles would be transported to channel courses or infiltrated into the soil profile. The two drops that occurred across stream drainages are obviously close enough to contribute surface or subsurface flows to these drainages should a rainfall event occur. Potential inputs from retardant residues include ammonium nitrogen or yellow prussiate of soda from the Fire-Trol product, both of which can be toxic to fish. Ammonium concentrations in stream flows have been measured to be 0.4 to 50 mg/L from direct applications of retardant to surface waters and 0.01 to 0.8 mg/L from surface runoff emanating from adjacent upland soils applied with retardant (Boivin and Bailor 1996).

Although products present in performance additives are likely to be less mobile within the soil profile than ammonium nitrogen, excessive precipitation could dissolve and transport the yellow prussiate of soda (YPS) component within Fire-Trol products into surface waters. YPS contains sodium ferrocyanide that can release free cyanide under exposure to UV radiation while in solution. The risk of creating levels toxic to fish through this mechanism has been shown to decrease significantly after applied residues are exposed to sunlight for 45 days or more before being dissolved into solution. Residues are likely no longer present as a source of these components to the system following this time period (Little and Calfee 2002).

Rains recorded during the August event were measured to be 0.32 inches, which were very likely insufficient to create surface flows within the intermittent drainage, especially considering the infiltration rates of the surface soils, low soil moistures present during the summer months and nearly level slopes of the immediately adjacent upland slopes. Runoff into the perennial reach of Odell Creek is also likely to have been very low from this rainfall event for these same reasons, in addition to the relatively controlled flow of this reach from spring-fed and lake outlet sources that limit flows above bankfull outside of spring peak flows.

Sulfates and nitrates that could reach surface flows of Odell Creek or Davis Lake via tributary groundwater sources after leaching through the soil profile should be in limited concentrations due to dilution factors provided by the volumes in each waterbody. Neither surface waterbody is a direct drinking water source and there are no water quality standards for nitrate in wild land surface waterbodies. There are two wells that provide drinking water at East and West Davis campgrounds located within a mile of three retardant drop points. These wells are drilled at a depth of 65 and 80 ft, respectively. National drinking water standards for nitrates in public drinking water supplies are 45 mg/l nitrate or 10 mg/l nitrate nitrogen (Stednick 1991). Pre-fire monitoring data of these supplies shows nitrate levels of <0.1 mg/l nitrate (North Creek Analytical 2003). The water sources have been shut off since the fire event and have not been measured for water quality. Regular protocol for these sources has been annual tests for nitrate and coliform levels.

Effects to Wildlife Habitat (Snags and Down Wood)

Key Issue: Effects to Wildlife Habitat

Snags and Down Wood: Salvage operations could negatively impact habitat for species dependent upon snags and down wood by removing snags. The Davis Fire created conditions that will provide a short-term benefit for cavity nesters and species that forage on the insect populations that result from high tree mortality events. Removal of merchantable material has the potential to limit the natural cycles of post-fire insect populations and the dynamics of dependent foraging species.

Attributes and Measures: Snag levels over time; years to recruitment of larger (≥20 inches dbh) snags; acres of habitat development.

Introduction

Snags and Down Wood

Dead wood (standing or down) plays an important role in overall ecosystem health, soil productivity and numerous species' habitat. It is crucial in the continuation of species that depend on snags for all or parts of their life cycle (Laudenslayer 2002). Bird and mammal species rely on the structure for dens, nests, resting, roosting, and/or feeding on the animals and organisms that use dead wood for all or parts of their life cycle. Snags come in all sizes and go through breakdown and decay processes that change them from standing hard to soft, then on the ground to continue decaying into soil nutrients.

Not every stage of the snag's demise is utilized by the same species, but rather a whole array at various stages or conditions. In forested environments 93 wildlife species are associated with snags. This includes 4 amphibians, 63 birds, and 26 mammal species (Rose et al 2001). Uses of snags include nesting, roosting, preening, foraging, perching, courtship, drumming, and hibernating. There were 86 vertebrate wildlife species associated with down wood, 58 were exclusively associated with down wood (Rose et al 2001).

O'Neil with others (2001) developed a matrix of habitat elements for wildlife species in Washington and Oregon. In Washington and Oregon there are 55 bird species, 28 mammal, 1 amphibian and 12 reptiles listed in the matrix that have fire as a habitat component. Most of those species rely on fire for opening up the under-story, maintaining open stands or in the case of the spotted owl, find it beneficial for developing trees with large branches. For the east slope of the Cascades the black-backed woodpecker, chipping sparrow, Lewis's woodpecker, brown creeper, Williamson's Sapsucker, hermit thrush, and olive-sided flycatcher are bird species that rely on habitats with old burn patches, open patches from wildfires, or snag/insect densities resulting from wildfire (Altman 2000). Those species whose populations actually increase with fire include three toed and black-backed woodpecker (populations peak 3-5 years post-fire), mountain bluebird (1-15 years post-fire) and olive-sided flycatcher (1-3 years post fire) (O'Neil 2001).

Stand structure often influences species that utilize snags. Frenzel (2002) noted snag density may be less important for white-headed woodpeckers than other woodpeckers since they forage mostly in live trees. He found the mean snag densities at nest sites to be 1.5 trees per acre. Nesting success was greatly influenced by the number of large green trees available at the nest site; specifically there was greatest success in stands where there were 12 ponderosa pine per acre greater than 21 inches diameter. Development of dense understories due to fire suppression is one cause of reduced white-headed woodpecker habitat. Goggans and others (1989) found nests excavated by three-toed and black-backed woodpeckers were in portions of lodgepole pine trees with heartrot. Three-toed habitat was predominately mixed conifer forest stands above 4500 ft elevation and black-backs predominately lodgepole pine forest stands below 4500 ft elevation. Both are associated with stands that are susceptible to attacks by bark beetles, generally mature and over-mature with high tree densities.

Both Saab and Dudley (1998) and Haggard and Gaines (2001) looked at the effects of stand-replacement fire and salvage logging on cavity nesting birds. Both studies found black-backed woodpeckers utilized the highest density of snags, and Lewis's woodpecker avoided high snag density areas. The numbers of snags retained varied by study:

Haggard and Gaines (2001) studied three post salvage snag densities in ponderosa pine/Douglas-fir high intensity burn: high densities were 37-80 snags/ha (14.8-32 snags/ac) with a mean dbh of 37.55cm (15 inches), medium densities were15-35 snags/ha (6- 14 snags/ac) with a mean of dbh =30.77 (12.3 inches) and low densities were 0-12 snags/ha (0-4.8 snags/ac) with a mean dbh of 31.56cm (12.6 inches). They found after salvage snag densities of 15-35 snags/ha (6-14/ac) ≥25cm (10") dbh provided the highest abundance, species richness, and nesting populations of cavity nesters. The study also found that snags > 48cm (19.2inches) provided nesting habitat for more species. At their study site moderate levels of snags, 21 snags per hectare (8.4/ac) >48cm (19 inches) dbh produced the highest nesting populations, supported multiple cavities, and were important for foraging. The study's time frame was 4 to 5 years post-harvest.

Saab and Dudley (1998) looked at no harvest and three levels of post salvage snag densities in a mixed conifer high intensity burn. Snag densities in unlogged level for small trees 9 inches to 20 inches dbh averaged 33 per acre and 7 per acre larger than 20 inches dbh. Wildlife prescribed salvage logged 50% of all merchantable trees greater than 12 inches dbh. Salvage-logged prescription on north slopes required leaving 6 snags per acre with 3 greater than 20 inches dbh, 2 between 12 and 20 inches dbh and 1 between 10 and 20 inches. The south slope prescription left 33% of the trees greater than 12 inches. They found amongst the treatments overall densities were similar, but species composition differed.

Both studies did not recommend leaving snags at specific densities, but rather recommended snags be left in varying densities to provide for a greater number and diversity of cavity dependent birds.

Looking at a scale larger than stand level and managing for varying densities of dead wood in green stands and post fire situations was recommended in much of the literature, (Rose et al 2001, Mellen et al 2003, Laudenslayer 2002, Saab and Dudley 1998, Haggard and Gaines 2001). Management guidelines for snags and down wood on the Crescent Ranger District are wide ranging. The Davis LSR Assessment (LSRA) set snag and down wood levels for the Davis LSR, other direction includes:

- Retain snags that are likely to persist until late-successional conditions (greater than 80 years old) have developed and large snags are being produced (NWFP S&G C-14);
- Retain coarse woody debris in quantities so that in the future it will still contain amounts similar to naturally regenerating stands (NWFP S&G C-14);
- In matrix… a minimum of 120 linear feet of logs per acre greater than or equal to 16 inches in diameter and 16 feet long should be retained. (NWFP S&G C-40);
- In matrix.. as a minimum retain snags within the harvest unit at levels sufficient to support species of cavity-nesting birds at 40 percent of potential population levels based on published guidelines and models (NWFP S&G-C-42);
- In matrix …for white-headed woodpecker, black-backed woodpecker, pygmy nuthatch and flammulated owl snags over 20 inches dbh may be marked for cutting only after retaining the best available snags (considering size, longevity, etc.) in sufficient numbers to meet 100 percent of the potential population levels of these four species (2001 amendment page S&G-34, 35);
- East of the range of the spotted owl… maintain snags of ≥ 21 inches dbh at 100% potential population levels of primary cavity excavators (1995 Regional Forester's Amendment No. 2, Appendix B p11)
- Use the best available science on species requirements (2001 amendment page S&G-34, 35 and 1995 Regional Forester's Amendment No. 2, Appendix B p11);

Levels of Snags to be Retained in Harvest Areas

The desired future conditions for snags and down wood is to retain a diversity of snag densities across the landscape to provide for a diversity of species, but still enable maintenance of the stands with fire, in the future. The goal is to retain sufficient snags for wildlife until stands reach an age that snag (20 inch plus dbh) recruitment is occurring. Snags at that point should reflect the "natural disturbance" regime. Information from DecAid will be used as the baseline for comparison. DecAID is a web-based advisory tool to help managers evaluate effects of forest conditions and existing or proposed management activities on organisms that use snags and down wood. It is a summary, synthesis, and integration of published scientific literature, research data, wildlife databases, forest inventory databases, and expert judgment and experience. It utilizes information from vegetation plots taken across the state for a given habitat type (Marcot 2003).

The snag retention strategy was developed to leave a wide range of densities across the landscape. The strategy consists of three parts:

1. Varying densities of snags would occur outside of units. There would be no harvest of snags within low and mixed fire intensity areas, and no removal of green trees that are dead or will die as a result of the fire. Large blocks within the 100% mortality (moderate and high intensity areas) where snag densities were too low to allow salvage would also be left.
2. High densities of snags would occur in 15% leave areas associated with the units.
3. A mosaic of varying densities by leaving 2-12 snags per acre within harvest units in addition to 15% retention areas. Pre-fire down wood and soft snags would not be removed and would not count toward the snags per acre to be left. To ensure longevity of snags across the area, all snags 36 inches in diameter and greater would be left in all units. Wherever possible snags would be clumped around the largest snag providing small clumps throughout the unit. To provide diversity in snag sizes varying diameter classes would be left. In some cases the smallest snags that would be in some way designated to be left during timber harvest would be 12 inches in diameter (ground based units) or 14 inches in diameter (helicopter based units). In other areas the smallest snag designated to be left would be 20 inches in diameter.

A combination of information and tools were used to determine snag levels to leave across the project area. Existing stand exam information and snag surveys were used as the baseline dataset in the Forest Vegetation Simulator with the Fire and Fuels Extension to simulate snag falldown and stand growth and development. DecAID provided a bibliography of the most recent research on snags and down wood. A review of the research, current direction from the Forest Plan, and the Davis Late Successional Reserve Assessment led to the following guidelines for retention. A more detailed description on the development of these guidelines can be found in Appendix D.

Table 3.11 Snag Retention for Harvest Units

Management Area	MSAs	Structure Managing For	Plant Associations	15% retention in Units	Average Snags/Acre Designated to be left*	Diameter Limit (No Harvest)[1]	Minimum Diameter Limit to be Designated to leave[2]
LSR	D,F,G, N, O	ponderosa pine/Douglas-fir fire climax	PP/DF and Drier Mixed Conifer Dry	Yes	5	36"+ dbh	14" in helicopter, 12" in ground based units
	Q, S, V	mix of conifer species climatic climax	Mixed Conifer Dry	Yes	12	36"+ dbh	14" in helicopter, 12" in ground based units
	P	transition between PP/DF and mixed conifer	Mixed Conifer Dry	Yes	8	36"+ dbh	20"[3]
	H,R,M, L, R ,U	lodgepole pine	lodgepole pine	Yes	10	36"+ dbh	Largest available
Matrix	N/A	ponderosa pine/Douglas-fir fire climax	PP/DF and Drier Mixed Conifer Dry	Yes	2	36"+ dbh	20"[3]
	N/A	mix of conifer species climatic climax	Mixed Conifer Dry	Yes	3	36"+ dbh	20"[3]
Eastside	N/A	ponderosa pine/Douglas-fir fire climax	PP/DF and Drier Mixed Conifer Dry	No	8	36"+ dbh	20"[3]
	N/A	mix of conifer species climatic climax	Mixed Conifer Dry	No	8	36"+ dbh	20"[3]

Alternative E LSR (Matrix and Eastside stay the same)	D,F,G,N,O	ponderosa pine/Douglas-fir fire climax	PP/DF and Drier Mixed Conifer Dry	No, but retention criteria for nests, slope etc. remain	all 36+ , Where the 36+ are less than 3/ac add an additional 2	36"+ dbh	20"[3]
	Q, S, V	mix of conifer species climatic climax	Mixed Conifer Dry		3 in addition to all 36+	36"+ dbh	20"[3]

*These are in addition to the retention areas where they apply. Because of the preference for clumping some acres may have more snags/acre, some may have less.

[1]Wherever possible snag clumps would be centered on 36" dbh and greater snags; where these do not occur snag clumps would be centered on largest available snag. Individual snags can be left where clumping is not possible.

[2]Smallest diameter snag to be considered for leaving.

[3]Where 20" dbh snags are not available the largest dbh snags will be left.

Snag clumps and leave areas will provide varying densities of down wood for the future. In addition all cull material would be left, and material > 20" at large end would not be included in grapple piles or other fuels treatments. There would be no removal of downed wood greater than 36" regardless of condition.

In the LSR, management strategy areas (MSAs) D, F, G, N, and O are to be managed primarily for bald eagles. The above table shows that these MSAs are to be managed in a ponderosa pine/Douglas-fir fire climax structure. Plant associations in these MSAs are primarily ponderosa pine/Douglas-fir or ponderosa pine dominated mixed conifer and the structure they are to be managed for is somewhat open or dispersed clumps of ponderosa pine and Douglas-fir generally found under a fire influence. Units in these MSAs will have 15% retention to provide dense clumps of snags in 2 to 20 acre patches. Across the units 5 snags per acre would be left in clumps around those snags 36 inches dbh and larger. These snags could be as small as 12 inches dbh in ground based harvest units or as small as 14 inches dbh in helicopter based harvest units. This would provide diversity in tree sizes and densities across the landscape. Spotted owls are the focal species for MSAs Q, S, and V. These MSAs are the more productive mixed conifer mixed conifer plant associations. Snag levels for species represented in the climatic climax of these plant associations generally require higher snag densities than the ponderosa pine. Along with the 15% retention, 12 snags per acre are to be left in harvest units in these MSAs in clumps around those snags 36 inches dbh and larger. Again snags as small as 12 inches dbh in ground based units and 14 inches dbh can be left. In all harvest units all snags 36 inches dbh and greater would be left. All previously existing soft snags would be retained and not counted toward densities within units. A more detailed description on the development of these guidelines can be found in Appendix D.

Analysis Process

The species we will focus on in this analysis are representative primary cavity excavators and insect foraging species that may be found in this area. They include: white-headed woodpecker, pygmy nuthatch, flammulated owl, black-back woodpecker, mountain bluebird, Lewis woodpecker, pileated woodpecker, northern flicker, olive-sided flycatcher. Species were chosen from NWFP survey and manage species (USDA 2001), USFWS Species of Conservation Concern (USFWS 2002) and A Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon (Altman 2000).

Table 3.12 Species with Dead Wood or Fire-created Habitat as a Primary Habitat Feature

Species	Status	Behavior	Habitat Feature/Conservation Focus	Habitat	Presence in Project Area	Oregon State Heritage Status Ranking
Lewis' Woodpecker	Migratory Focal Species, Bird of Conservation Concern	primary cavity excavator	patches of burned old forest	Old Growth Ponderosa Pine	Unknown	S3
Flammulated Owl	Migratory Focal Species, NWFP Survey & Manage, Bird of Conservation Concern	secondary cavity nester	large snags	Old Growth Ponderosa Pine	Documented	S4
White-Headed Woodpecker	NWFP Survey & Manage, Migratory Bird Focal Species, Bird of Conservation Concern	primary cavity excavator	large patches of old forest with large snags	Old Growth Ponderosa Pine	Documented	S3
Pygmy Nuthatch	NWFP Survey & Manage	primary cavity excavator	large trees	Pine Forest	Documented	S4
Williamsons' Sapsucker	Migratory Focal Species, Bird of Conservation Concern	primary cavity excavator	large snags	Mixed Conifer	Documented	S4
Pileated Woodpecker	MIS	primary cavity excavator	Large snags/down wood	Mixed Conifer	Documented	S4
Black-back Woodpecker	NWFP Survey & Manage, MIS, Migratory Focal Species	primary cavity excavator	Old Growth	Lodgepole Pine	Documented	S3
American Marten	MIS	secondary cavity user, preys on rodents found in abundant down wood	Snags and down wood	Mixed, Complex	Documented	S3
Northern flicker	MIS	primary cavity excavator	Snags and down wood	Mixed, Complex	Documented	S5
Olive-sided Flycatcher	Bird of Conservation Concern	aerial insectivore	Fire created openings in old forest	Mixed, Complex	Unknown	S4
Mountain bluebird	None - population increase after a fire	secondary cavity nester	burned areas	Mixed, Complex	Documented	S4

Stands were modeled using the Forest Vegetation Simulator with the Fire and Fuels Extension (FVS-FFE). This model provides snag fall down rates that were developed in Central Oregon. See Vegetation explanation of FVS-FFE. Information for the model was obtained from stand exams. Surveys consisting of 100 % count of all snags 8 inches in diameter and greater were completed in previously harvested units. Snag levels for stands with 100% moderate to high intensity burn without stand exam information were estimated using an average of adjacent stands within the same plant association. Snag levels for stands with less than 100% moderate to high intensity burn were estimated by using the green stand data. The FVS-FEE modeled fire through the stand to an intensity that approximated the mortality in the stand. It must be remembered that FVS is a modeling tool based on the best information available. It gives conditions that may occur given the assumptions of the model. It is not an absolute answer. Used in the same manner for all alternatives, it provides a basis for comparison.

Tolerance levels for species, snag levels and down wood used to provide a basis for comparison are taken from the following tables in DecAID.

Ponderosa pine baseline snag levels and density categories: PPDF_L inv.-14 and -15.

Mixed conifer baseline snag levels and density categories: EMC_ECB_L inv.-14 and -15.

Species Tolerance levels: EMC_O.sp-23 and PPDF_O.sp-23 for recent post fire
EMC_S/L.sp-22 and PPDF_O.sp-22 for other than recent post fire.

Down wood tolerance limits: Table inv-5a

Existing Conditions

Large portions of the area have been harvested. Treatments varied across the planning area from removing only the largest trees in the early 1900, and clearcuts in the 1970s to most recently understory thinning that left the largest trees. Harvest regimes along with fire suppression resulted in varying conditions across the landscape. Prior to the fire the majority of the area was in a multi-story mid-late stage with many trees reaching 15-30 inch dbh. There was a lack of single story mid-late and old forest structure. The Davis LSRA found tree densities above historic ranges that put the area at risk for insect and disease. The LSRA also found the MSAs in the fire area to be marginally meeting dead wood needs for wildlife.

Table 3.13 Pre-Fire Structural Stages in Project Area

Structural Stage	Habitat Type*	Acres	% of Area
ES **Early Seral/Stand Initiation**	Lodgepole Pine	973	5%
	Mountain Hemlock	26	0.1%
	Mixed Conifer	1,340	6%
	Ponderosa Pine/Douglas-fir	2,470	12%
ES Total		**4,809**	23%
SECC **Stem Exclusion-Closed Canopy**	Lodgepole Pine	5	0%
SECC Total		**5**	0%
MM **Mid-Late Forest Multistory**	Lodgepole Pine	2,109	10%
	Mountain Hemlock	460	2%
	Mixed Conifer	5,550	26%
	Ponderosa pine/Douglas-fir	5,575	26%

Total MM		**13,643**	65%
LM **Old Forest Multistory**	Lodgepole Pine	205	1%
	Mixed Conifer	1,665	8%
LM Total		**1,870**	9%
Floodplain/Riparian Total		**708**	3%
Grand Total		**21,035**	100%

*Ponderosa dominated mixed conifer plant associations have been combined with the Ponderosa pine/Douglas-fir habitat.

The fire burned intensely over much of the area. There was little to no mosaic through the "gut" of the fire. Several of the larger regeneration stands had portions survive, providing some green tree relief in a sea of dead. A mosaic of burn intensity occurred around the edges of the fire where burnout operations were completed to corral the blaze. Structure as a result of the fire left most the area in a stand initiation stage.

Table 3.14 Post Fire Structural Stage across Davis Fire Area

Post-Fire Structural Stage	Habitat Type*	Fire Intensity			
		Unburned	Low	Moderate	High
SI **Stand Initiation**	Lodgepole Pine		198	1,495	688
	Mountain Hemlock			73	11
	Mixed Conifer		435	1,401	4,955
	Ponderosa pine/Douglas-fir		93	1,498	4,303
SI Total		**0 (0%)**	**726 (3.5%)**	**4,467 (21.2%)**	**9,962 (47.4%)**
ES **Early Seral**	Lodgepole Pine	394			
	Mixed Conifer	464			
	Ponderosa pine/Douglas-fir	57			
	ES Total	**915 (4.3%)**	**0**	**0**	**0**
MM **Mid-Late Forest Multistory**	Lodgepole Pine	170			
	Mixed Conifer	334			
	Ponderosa pine/Douglas-fir	40			
	Total MM	**544 (2.6%)**	**0**	**0**	**0**
LM **Old Forest Multistory**	Lodgepole Pine	10			
	Mixed Conifer	4			
	Total LM	**14 (0.07%)**	**0**	**0**	**0**
OFSS	Lodgepole Pine		10	23	

Old Forest Single Story	Mixed Conifer		65	193	
	OFSS Total	**0**	**75 (0.4%)**	**216 (1.0%)**	**0**
SEOC Stem Exclusion-Open Canopy	Lodgepole Pine		293		
	Mountain Hemlock		347		
	Mixed Conifer		1015		
	Ponderosa pine/Douglas-fir		908	844	
	SEOC Total	**0**	**2,563 (12.2%)**	**844 (4.0%)**	**0**
	Floodplain/Riparian Total	220	383	39	67
	Grand Total	**1,693 (8%)**	**3,747 (17.8%)**	**5,566 (26.5%)**	**10,029 (47.7%)**

*Ponderosa dominated mixed conifer plant associations have been combined with the Ponderosa pine/Douglas-fir habitat.

Ponderosa Pine Habitats – Lewis's Woodpecker, White-Headed Woodpecker, Pygmy Nuthatch

Habitat for the Lewis's woodpecker, a migrant in this part of its range, includes old-forest, single-storied ponderosa pine. Burned ponderosa pine forests created by stand-replacing fires provide highly productive habitats as compared to unburned pine (Wisdom 2000). Lewis's woodpeckers feed on flying insects and are not strong cavity excavators. They require large snags in an advanced state of decay that are easy to excavate, or they use old cavities created by other woodpeckers. Nest trees generally average 17 inches to 44 inches (Saab and Dudley 1998, Wisdom et al 2000). White-headed woodpeckers and pygmy nuthatches share similar habitat of large open ponderosa pine, low shrub levels and large snags. The white-headed woodpecker is a primary cavity excavator of soft snags, while the pygmy nuthatch is a secondary cavity nester and can take advantage of natural cavities as well as woodpecker created cavities. Both species prefer larger diameter trees than the Lewis's woodpecker, averaging 23 inches for the pygmy nuthatch and 31 inches for the white-headed woodpecker (Wisdom 2000). On the Winema National Forest, just to the south of the project area, white-headed woodpeckers were found to be using small-diameter trees, log in a slash pile and upturned roots (6-13" dbh) where large snags were uncommon (Frenzel 2002). There have been sightings of white-headed woodpeckers and pygmy nuthatches in the project area. To date no Lewis's woodpecker has been sighted. In evaluating landscape predictor variables for Lewis' woodpecker, Saab (2002) found a negative relation to burned ponderosa pine/Douglas-fir with high crown closure. It is possible that crown closures are too high for Lewis's at this time.

Although there are approximately 8,000 acres of ponderosa pine dominated plant associations, there was very little habitat for Lewis's woodpecker, white-headed woodpecker and pygmy nuthatch in the project area prior to the fire. Ponderosa pine stands have had shade tolerant trees come in the understory, creating dense multi-story stands. Recent management (thinning from below) on approximately 900 acres began to convert some stands to a single story old growth stand. Snag levels in this habitat were generally higher in the lower diameters with approximately 4 per acre greater than 12 inches dbh and 1 per acre greater than 20 inches dbh.

This number would meet the Deschutes National Forest Wildlife Tree and Log Implementation Strategy (WTLI strategy) (USDA 1994 WTLI) and Eastside Screen standard for 100% maximum population potential (mpp) for woodpecker of 3.87 snags per acre greater than 10" with .06 per acre greater than 20 inches DBH. It would meet the low end of the LSRA standard for ponderosa pine of 1-5 greater than 25 inches.

Using the information gathered from the pre-harvest snag tallies of timber sales, (a sample of 1,800 acres), DecAID would rate these levels at the 80% tolerance level for white-headed woodpecker (WHWO), and between the 30% and 50% tolerance level in the generic "all species" category. Tolerance level (t.l.) is the percent of the population that would use that density. For example, for a population of 100 individual white-headed woodpeckers, 80 of them would use habitat with at least 3.7 snags per acre greater than or equal to10 inches dbh. In looking at all species that use snags, if there were 100 species 50 of those species would use habitat with a snag density of 2.5 snags per acre

greater than or equal to 20 inches dbh, the remaining 50 would select for higher densities reaching 80 of the species at a snag density of 5.3 snags per acre greater than or equal to 20 inches dbh. Tolerance levels are given in 2 class sizes: snags greater than or equal to 10 inches dbh, and greater than or equal to 20 inches dbh. Generally, lower densities are needed with larger diameter snags.

Table 3.15 Pre-harvest Snag Data from Timber Sales, Ponderosa Habitats

Sale	Acres	Snags 12" dbh and Larger	Snags 21" dbh and larger
Lope	988	1,912	656
Double	245	900	122
Bird	629	2,932	638
Total	1,862	6,744	1,416
	Per Acre	**3.62**	**0.76**

Table 3.16 Tolerance Levels for White-Headed Woodpecker

	30% Tolerance Level Snag Density (#/acre)	50% Tolerance Level Snag Density (#/acre)	80% Tolerance Level Snag Density (#/acre)
Snag size ≥ 10 inches	0.3	1.7	3.7
Snag size ≥ 20 inches	0.2	1.3	2.8
All Species High Density Clumps			
Snag size ≥ 10 inches	3.2	5.3	15
Snag size ≥ 20 inches	1.8	2.5	5.3

Tolerance levels were not available for Lewis's woodpecker and pygmy nuthatch.

The fire created habitat for the Lewis's and white-headed woodpecker and pygmy nuthatch on nearly 3,000 acres of underburned or mixed intensities ponderosa pine habitat or mixed conifer habitat where the resulting structure was single story (old forest single story, OFSS) or open canopy (stem exclusion /open canopy, SEOC). An additional 13,000 acres of moderate and high intensity burn could provide habitat for the Lewis' woodpecker as snag densities become favorable. It is questionable how suitable these acres would be for white-headed woodpeckers or pygmy nuthatch. White-headed woodpeckers were found in both study areas of ponderosa pine/Douglas-fir in Washington and Idaho, but densities were too low for statistical analysis. Pygmy nuthatches were not found in either study area. That may be in part because of reliance on pine seed sources for the white-headed, or leaf insects for the nuthatch as seasonal parts of their diet (Marshall et al 2003).

There is no information on prefire down wood levels. Post fire fuels inventories results for ponderosa pine range from 3.45 to 21.8 tons per acre of fuels greater than 3 inches. This is harder to put into terms of the WLTI strategy where 6 logs per acre in various stages of decay are to be left or the Eastside screens requirements of 3-6 pieces with diameter of 12 inches at the small end, greater than 6 feet long; or equal to 20-40 lineal feet. Levels appear to meet the LSRA standards for ponderosa pine of 10 to 15 tons per acre, it is unknown what portion meet the minimum log diameters of 20 inches

DecAID measures down wood as percent cover. This is a measure of the percentage of the ground surface covered by woody material. The range of 3.45 to 21.8 tons per acre converted to percent cover would be a range of 0.63 to 4.01 percent cover. The value from DecAID 1.8 percent cover is the 80% tolerance limit in this habitat and is approximately 10 tons/acre. LSR standards for ponderosa pine would meet or exceed the 80% tolerance level of 1.8 percent cover.

Mixed Conifer Habitats – Williamson Sapsucker, Pileated Woodpecker

Williamson sapsuckers, a summer resident, prefer large decadent snags in mixed conifer or ponderosa pine forest. They feed mostly on sap from "wells" they drill in ponderosa pine or Douglas-fir trees, phloem fibers, cambium, and insects. They are not strong cavity excavators and select soft decayed wood in about any tree species for nesting (Marshall et al 2003). They favor larger trees, generally averaging 27" dbh. Pileated woodpeckers share similar habitats of denser mixed conifer forests. They are rarely found in pure ponderosa pine forests. The largest woodpecker in the U.S., it uses large snags for nesting, generally averaging 27-33 inches in diameter. A major food source of the pileated woodpecker includes carpenter ants found in decaying snags and down logs (Aubry and Raley 2002b). Both woodpeckers have been found in unburned or underburned areas of the project area post fire. They have not been found in fire areas of 100% mortality.

There were approximately 8,000 acres of mixed conifer habitat prior to the fire. Pre-harvest snag data from timber sales scheduled for understory thinning in mixed conifer habitats averaged 12 snags per acre greater than 11 inches dbh and 4 snags per acre greater than 20 inches dbh. This would exceed the mixed conifer WLTI/Eastside strategies for 100% mpp of 3.93 snags per acre greater than 10 inches with .06 snags per acre greater than 20 inches and exceed the LSRA mixed conifer standard of 3-9 snags per acre greater than 12 inches dbh with 0.75 to 2 per acre greater than 20 inches dbh.

Table 3.17 Pre-harvest Snag Data from Timber Sales in Mixed Conifer Habitats

Sale	Acres	Snags 12" dbh and larger	Snags 21" dbh and larger
Bird	185	1,158	213
Davis Top	922	12,518	4,254
Total	1,107	13,676	4,467
	Per Acre	**12.35**	**4.04**

In DecAID terms this would be above the 50% tolerance level for cavity nesting birds (CNB), and below the 50% tolerance level for pileated woodpeckers (PIWO). There currently are no tolerance levels defined for the Williamson sapsucker in DecAID.

Table 3.18 Tolerance Levels for Pileated Woodpecker

	Snag Size: ≥ 10 inches			**Snag Size: ≥ 20 inches**		
Species	30% TL Snag snags/acre	50% TL Snag snags/acre	80% TL Snag snags/acre	30% TL Snag snags/acre	50% TL Snag snags/acre	80% TL Snag snags/acre
CNB					2.4	
PIWO		30.4			7.32	
All species based on vegetation data, not species data						
All	3.6	9	21	5.3	5.3	9
Higher Density Clumps*		32	32		8	8

*Vary densities 30%-80% to provide for all species, including some area with higher density clumps.

The Davis fire burned most of the mixed conifer habitats. Approximately 6,000 acres burned with high or moderate intensity killing all trees; 1,000 acres underburned creating a mosaic; and 800 acres unburned. There are

approximately 2,000 acres of remaining habitat (underburn and unburned mixed conifer) for the Williamson sapsucker and pileated woodpeckers.

There is no information on prefire down wood levels. Post fire fuels inventories results for mixed conifer range from 6.93 to 15.91 tons per acre of fuels greater than 3 inches. The WLTI strategies recommend 6 logs per acre in various stages of decay to be left for every vegetative condition; the Davis LSRA recommendation for mixed conifer is 12 to 24 tons per acre, with log diameters larger than 15 inches (converted to DecAID terms of 2.29 to 4.58). Eastside screens direction for mixed conifer is 15 to 20 pieces per acre with a 12 inch diameter at the small end, greater than 8 feet long; or equal to 100 to 140 lineal feet.

DecAID conversion of 6.93 to 15.91 tons per acre would be a range of 1.32 to 3.04 percent cover. This would put all the areas where the inventory was done in the 30% to 50% tolerance limit (2.1 to 3.1 percent cover). Levels reflected by the surveys are within the 30 percent tolerance level and below. The 80% tolerance limit of 5.4 percent cover is approximately 33 tons per acre. This is higher than the LSR standard, and may reflect the lack of fire in some of these plant associations, a warning given in DecAID.

Lodgepole Pine Habitats – Black-backed Woodpecker

Wisdom (2000) describes source habitats for blacked-backed woodpecker as a year round resident that occurs in various forest types. Within its range it is most abundant in recently burned forests, but in Oregon, bark-beetle-killed forests are frequently occupied. Marshall et al (2003) reports for this species the "center of abundance" in Oregon is the "lodgepole pine forest east of the Cascade crest between Bend and Klamath Falls." Endemic levels of mountain pine beetles, common in lodgepole pine (10"+ dbh and 170 tpa), provide a constant food source in small pockets and individual trees scattered across the forest. In a study conducted on the Deschutes National Forest, Goggins (1989) found black-backed woodpeckers used stands with a mean dbh of 8 inches for nesting. Mean nest tree dbh was 11 inches. All nest trees were lodgepole pine with heart rot. Soft wood appears to be required for excavating cavities. All of the nests in the study were in lodgepole pine stands and 93% of foraging took place in lodgepole pine forest. Goggins found mountain pine beetles had infested 81% of the trees used for foraging. Recent dead trees were used most often (68%) for foraging.

Within the project area approximately 3,300 acres of lodgepole pine habitats existed prior to the Davis fire, including 2,430 acres within the LSR. The majority of lodgepole pine within the LSR (2,420 acres) are within MSA D, H, L, M, and R where the black-backed woodpeckers are the emphasis species or to given consideration for management of lodgepole habitat. Within MSA M, there were also 483 acres of an old growth lodgepole pine area. The fire reduced green base lodgepole habitat to 800 acres, but created 15,500 acres of burned habitat inside and outside of the LSR. The burned old growth area continues to provide habitat for the black-backed woodpecker and will continue to provide habitat in its current condition for the next 5 years.

Wood boring insects that come in with fire differ from mountain bark-beetle. Marshall (2003) warns that burned forests and bark-beetle outbreaks should not be considered equivalent habitats. Wisdom contrasted nesting success of 68.5 percent in Oregon bark beetle infested forest with 100 percent success in burned forests of western Idaho and northwestern Wyoming. Squirrel predation accounted for the nest losses in Oregon lodgepole pine forest. In the Idaho fire colonization of the large burn areas by squirrels did not take place during the first 3 years after the fire. It should be noted however that black-back population increases in fire areas lasts for 5 years (Saab and Dudley 1998), whereas large-scale infestations of mountain bark-beetle in the lodgepole pine forests on the Deschutes National Forest last 10 years. Small-scale infestations of mountain bark-beetles in lodgepole pine or mixed conifer forest occur on a never ending cycle (Eglitis et al 2004). Snag densities in this habitat type vary widely. A bark beetle infestation occurred in the early 1990's killing large blocks of lodgepole. Habitat was probably on a decline as the bark beetles were moving on and snags created during the infestation were falling.

Information is available from post fire surveys that were completed. From a sample across the planning area of 486 acres there were on average 5.4 snags per acre greater than 10 inches dbh with 1 per acre greater than 12 inches dbh. This exceeds the lodgepole pine WLTI/Eastside screens strategy of 2.58 trees per acre greater than 10 inches dbh with 0.66 trees per acre greater than 12 inches dbh, and falls short of the 13-17 snags per acre greater than 11 inches dbh recommended within the LSRA.

There is no information of prefire down wood levels. Post fire fuels inventories results for lodgepole pine range from 6.21 to 19.32 tons per acre of fuels greater than 3 inches. The WLTI strategy recommends 6 logs per acre in various stages of decay are to be left for every vegetative condition, the LSRA recommendation in lodgepole pine is

8 to 12 tons per acre, with log diameters larger than 15 inches or converted to DecAID terms of 2.71 to 4.06. Eastside screens direction for lodgepole pine is 15 to 20 pieces per acre with an 8 inch diameter at the small end, greater than 8 feet long; or equal to 120 to 160 lineal feet.

DecAID measures down wood as a percent of the ground surface covered by woody material. The range of 6.93 to 19.32 tons per acre conversion would be a range of 1.32 to 6.54 percent cover. This would put all the areas where the inventory was completed in the 30% to 50% tolerance limit (2.1 – 3.1 percent cover). Wildlife species information is lacking in DecAID for lodgepole pine.

Complex habitats – Flammulated owl, American marten, Mountain bluebird, Northern flicker, Olive-sided flycatcher

Wisdom (2000) combined the flammulated owl and American marten with the northern goshawk and fisher because they share source habitats. He describes the source habitat as late seral stages of the montane community group and young forests with sufficient large-diameter snags and logs. The flammulated owls are found in ponderosa pine dominated stands with dispersed dense thickets and grassy openings. They utilize cavities in live or dead trees created by pileated woodpeckers or northern flicker. The average diameter of snags and trees used for nesting were 22 and 28 inches (Marshall et al 2003).

American marten are found in a variety of habitats with large (20 inches dbh or larger) diameter trees, snags and logs. They use snags and logs with intermediate levels of decay with greatest use in the larger (30 inches in diameter or larger) size classes when available (Raphael and Jones 1997). Canopy cover plays a greater role in winter where marten select for higher canopy cover during snow periods. A study conducted in lodgepole pine forest of the Winema National Forest Mountain, south of the project area, estimated 0.2 live trees, 0.3 snags, 0.6 logs and 1.3 slash piles /ha (0.08 live, 0.12 snags, 0.24 logs, and 0.52 slash piles per acre) of appropriate size would meet denning and resting needs (Raphael and Jones 1997).

The hairy woodpecker is somewhat of a generalist that uses all types of habitat. They tend to prefer open older forests but are found in thinned younger stands. The hairy woodpecker readily moves into burned areas. Blue-birds are the most diverse in this group utilizing all forest types for nesting and openings for foraging. It is associated with burned areas that have openings and fairly high densities of snags. A secondary cavity nester, it prefers cavities created by the northern flicker. The northern flicker is a most unconventional woodpecker. It feeds on ants, beetles and other insects on the ground and nests in open stands of older trees where there are larger snags, 13-22 inches dbh, with some decay. The key habitat features for all these species are down logs and snags. The olive-sided flycatcher, an aerial insectivore, prefers forest openings or edge habitats where forest meets meadows, harvest units, rivers, bogs, marshes etc. (Marshall et al 2003). Nesting success was highest within forest burns where snags and scattered tall, live trees remain (Marshall et al 2003, Sallabanks et al 2001).

Prior to the fire, habitat for most of these species occurred scattered across the planning area in 15,000 acres of multi-story mid, late and old forest. The olive-sided flycatcher probably utilized edge habitat along the forest/lake margin or poor quality edge habitats along old harvest units. Existing snag levels varied across the landscape ranging from 3 to 12 snags per acre.

Table 3.19 Pre-harvest snag levels in timber sales in Mixed Conifer and Ponderosa pine/ Douglas-fir

PP Habitats				MC Habitats			
Sale	**Acres**	**Snags 12" dbh and larger**	**Snags 21" dbh and larger**	**Sale**	**Acres**	**Snags 12" dbh and larger**	**Snags 21" dbh and larger**
Lope	988	2,912	656	**Bird**	185	1,158	213
Double	245	900	122	**Davis Top**	922	12,518	4,254
Bird	629	2,932	638				
Total	**1,862**	**6,744**	**1,416**	**Total**	**1,107**	**13,676**	**4,467**
	Per Acre	**3.62**	**0.76**		**Per Acre**	**12.35**	**4.04**

These levels provide habitat below the 50% tolerance level for American marten (AMMA), above the 50% tolerance level for cavity nesting birds (CNB) species in the mixed conifer habitats. In DecAID there currently are no pre-fire tolerance levels for any of these species other than American marten and cavity nesting birds as a group.

Table 3.20 Tolerance Levels for American Marten

	Snag Size: ≥ 10 inches			**Snag Size: ≥ 20 inches**		
Species	50% TL Snag Density	50% TL Snag Density	80% TL Snag Density	50% TL Snag Density	50% TL Snag Density	80% TL Snag Density
AMMA		16.2			5	
CNB					2.4	
All species based on vegetation data, not species data						
All	3.6	9	21	5.3	5.3	9
Higher Density Clumps*		32	32		8	8

* Vary densities 30%-80% to provide for all species, including some areas with higher density clumps.

Fire reduced the habitat to 5,000 acres of unburned and low intensity burn areas for the flammulated owl and American marten. The fire increased habitat to approximately 16,000 acres for the northern flicker, mountain blue-bird and olive-sided flycatcher. These species are less dependent on a green component or canopy cover. Marshal et al (2002) noted that mountain blue-birds and olive-sided flycatchers increased in population after a fire. There was not a mosaic of green trees scattered through-out this fire, so habitat may be over estimated and limited to edges with green trees or mixed intensity areas.

Environmental Consequences

Effects Common to all Alternatives including No Action

In areas of 100 percent mortality there are no green trees to provide for long term snag and down wood recruitment. Over time existing snags fall and create down wood. The smallest material falls first, the larger the diameter the longer it remains standing. Ponderosa pine snags tend to fall sooner than Douglas-fir snags. There would be variation across the landscape in the untreated areas.

In areas where fire was of low intensity, there will be a flush of snag recruitment as those trees damaged or stressed by the fire die. The flush of recruitment would be limited as the thinning decreases stress on the surrounding trees, given growing space there would not be snag recruitment within these stands for several decades. This thinning of the stands and initial increase of snags will benefit those species that select for more open habitats such as the white-headed woodpecker, pygmy nuthatch and mountain bluebird. There is no harvest proposed within unburned, low intensity or mixed intensity areas.

Areas that did not burn will continue to provide for species that prefer dense stands or complex habitats, such as the American martin, Williamson woodpecker and pileated woodpecker.

Effects Common to all Action Alternatives

Removal of snags through salvage logging would reduce amount of habitat for those species whose populations increase in burned forests. The degree to which they are affected can be correlated with densities provided across the landscape over time. Habitat reduction would be greatest for species such as the black-backed woodpecker,

mountain blue bird and olive-sided flycatcher, Lewis's woodpecker to a lesser degree, American marten potentially not at all with the retention of the largest snag components. Retention of snags over time when green tree conditions provide other needed components and recruitment of large diameter snags would be most important to species such as the American marten, pileated woodpecker, flammulated owl, white-headed woodpecker and the pygmy nuthatch. For these species the number of acres planted in the mixed conifer or ponderosa pine/Douglas-fir habitats becomes important in establishing habitat. Planting would reduce the number of acres that would go through a lodgepole pine successional stage, reducing potential black-backed woodpecker.

There will be no large green tree removal with any of the alternatives. Trees damaged during the fire that have any green needles remaining will be part of snag recruitment over time. Fuels treatments would thin small diameter trees. To maximize habitat left over time all snags and down wood 36 inches in diameter would be retained, down wood existing prior to the fire would remain, all cull material would be left on site in the largest pieces possible and cull material 14" and larger at the small end would not be put into slash piles. Treatment units would have 15% left untreated to provide areas of high density clumps of snags and future down wood. Low density clumps of snags and future down wood would be provided within units. Post harvest fuels treatments would reduce approximately 40-60% of the small diameter material in ground based units. In helicopter and skyline units material under 12 inches would be felled and jackpot burn. There would be no removal of snags greater than 12 inches in any of the fuels treatments. Relegation of snags and future down wood to leave areas, patches, and pockets allows for easier protection of these structures when prescribed fire is used in the future.

The alternatives provide for all the species at varying levels. Alternatives B and C reduce habitat for black backed woodpeckers to the greatest degree, while providing recovery of habitat for the white-headed woodpecker, pygmy nuthatch, flammulated owl and American marten with development of stands to the recruitment of large diameter snags sooner than Alternative A and over a larger area than Alternatives D and E.

All alternatives underestimate the density of snags by varying degrees. The 15% retention areas have not been calculated in. These high density areas play an important mitigation role for those species that select areas of high snag densities.

Ponderosa Pine Habitats – Lewis' Woodpecker, White-Headed Woodpecker, Pygmy Nuthatch

Alternative A –No Action

Direct and Indirect Effects

Snag densities in this habitat occur in various densities across the planning area. At what would be post harvest (2006) more than 40% of the ponderosa pine habitat in the project area has snag densities that exceed 40 trees per acre (solid green on the chart), with 4-8 of those trees per acre 20 inches dbh and larger (open green line on the chart). After 40 years (2046) the density ranges between 0-8 snags per acre (open blue line on the chart) with a larger range of those over 20 inches dbh of 0-12 snags per acre (solid blue on the chart). In the areas of 100% mortality recovery of pine habitats would occur over time. The time line for this is dependent on many variables and is estimated to be approximately 150-200 years over those areas that experienced moderate or high burn intensity. Habitat for the Lewis woodpecker would increase in the short term, as snag densities decrease to the species preferred level and decay condition.

Snag densities at 100 years would be recruited from stands with an average diameter of 10 inches and consist mostly of lodgepole pine. There would be no recruitment of snags greater than 20" dbh.

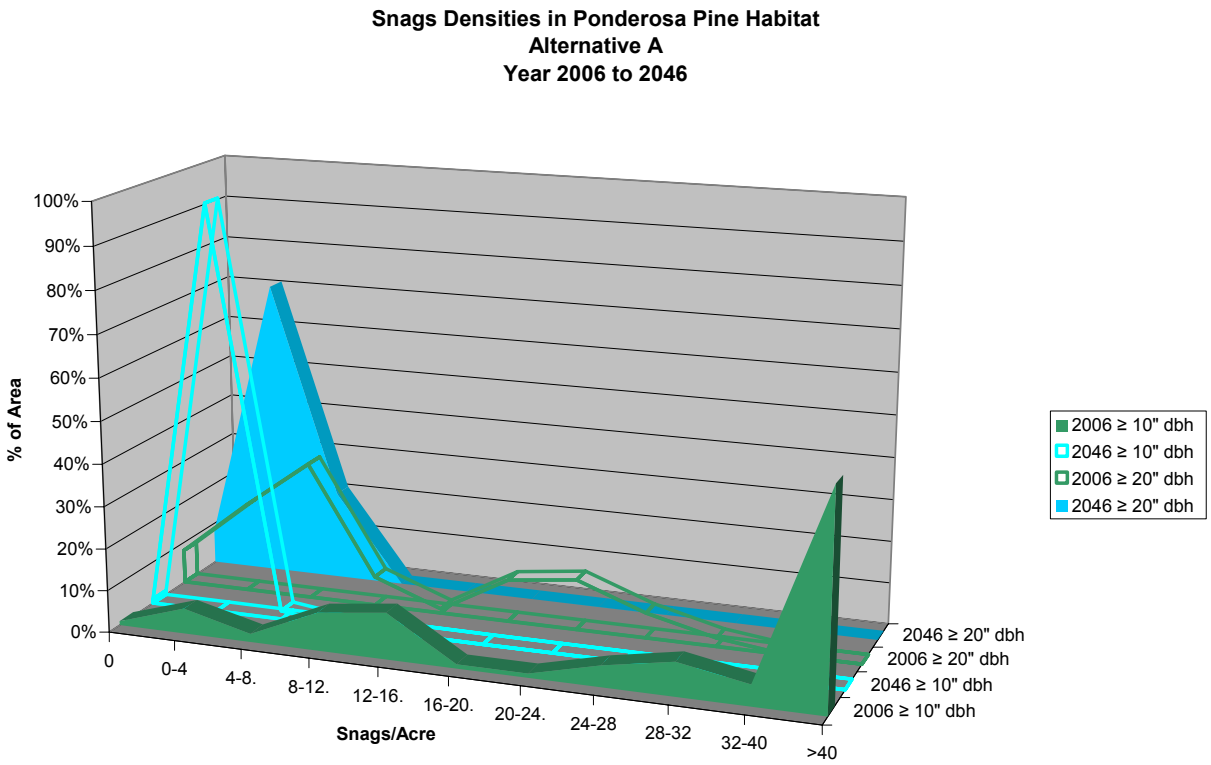


Figure 3.2 Snag Densities in Ponderosa Pine Habitat Over Time, Alternative A

Tolerance levels found in DecAID for ponderosa pine/Douglas-fir habitats recent post fire (Table PP/DF_L.sp-23) were used to predict habitat "potential" across the planning area and as a comparison between alternatives. The densities fall within the 80 percent tolerance level for white-headed woodpeckers on 17% of the planning area, and 40% of the planning area for Lewis's woodpecker. Approximately 45% of the matrix (2,790 acres) provides habitat at the 30% tolerance levels. Snag levels are only part of the story. Large ponderosa pines, providing seeds for the winter food source, would not be developing over 6,600 acres of 100% mortality (moderate and intense burn).

Table 3.21 Acres of Habitat by Tolerance Level by Species

Species	Below 30 TL		30% TL		50% TL		80% TL		Total Acres*	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
White-headed Woodpecker	***4549***	24%	***5751***	30%	***5395***	29%	***3262***	17%	***18957***	100%
Lewis's Woodpecker	***1453***	8%	***4185***	22%	***5721***	30%	***7597***	40%	***18957***	100%
*Total does not include approximately 2,000 acres of the 21,000 acre project area where there currently is no data.										

There are no tolerance levels available for the pygmy nuthatch.

Existing down wood ranging from 3.45 to 21.8 tons per acre converted to percent cover would be a range of 0.63 to 4.01 percent cover. Down wood habitat in this habitat type would not exceed historic levels initially, but over time as snags fell they would exceed historic levels. It would take several burn cycles to return it to historic levels, potentially destroying any habitat that has developed. See Fuels Section.

Alternatives B and C

Direct and Indirect Effects

Alternative B and C remove snags from 3,100 acres of formerly ponderosa pine habitat in the areas of 100% mortality. Removal of snags reduces the densities in this habitat across the planning area. With a combination of low density clumps across the units, 15% high density leave areas and 61% of this habitat type untreated, post harvest distribution of snags has 30% of the habitat type exceeding 40 snags per acre; 61% of the area with snag levels exceeding 12 snags per acre and 62% of the area with 4 or more snags per acre over 20 inch dbh. After 40 years the density ranges between 0-4 snags per acre, similar to Alternative A, but with fewer snags over 20 inches. At age 40, fire could be used to maintain stands. At 100 years past harvest, planted stands would average 14 inches dbh. The range of tree sizes include diameters of 20 inches. Modeling shows snag recruitment occurring mostly in the 10-20" range with snags greater than 20" diameter just starting to show at densities less than 1 per acre. Ponderosa pine would be dominating these areas, not lodgepole as in Alternative A.

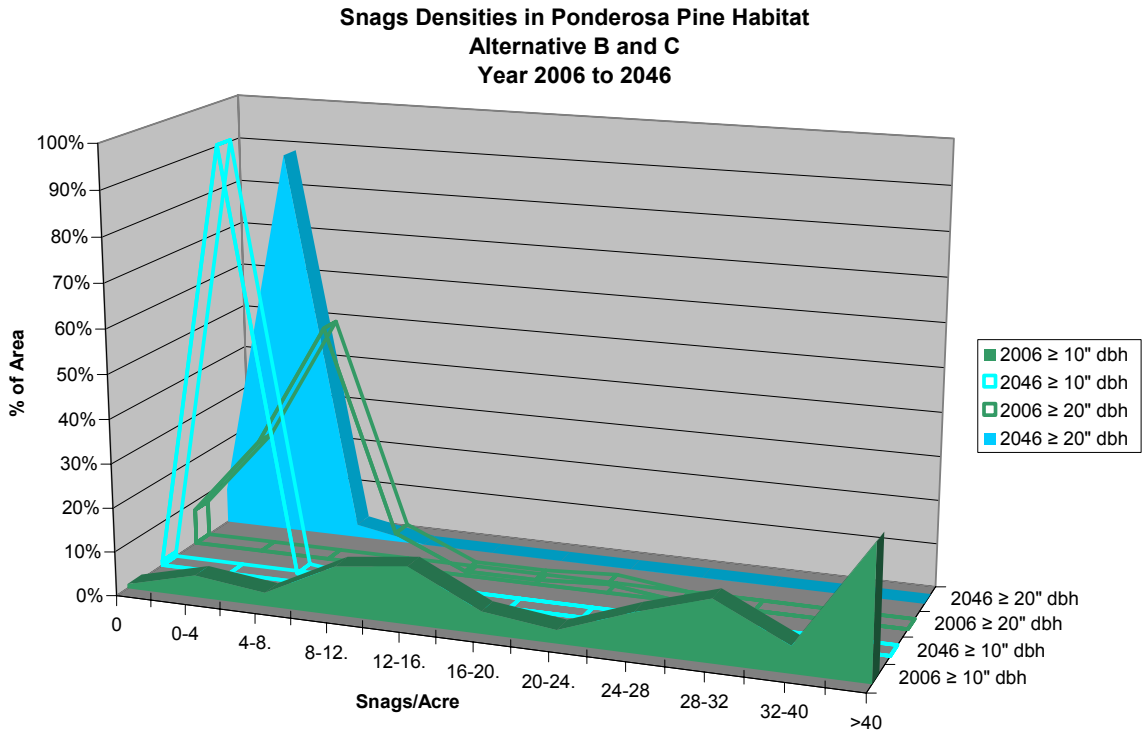


Figure 3.3 Snag Densities in Ponderosa Pine Habitat Over Time, Alternatives B and C

Habitat for the Lewis's woodpecker would increase in the harvest units in short term for foraging, and as snag densities decrease to the species preferred level in the unharvested areas. Nesting would be limited initially to those preexisting snags that survived the fire and have the decay conditions the Lewis's woodpecker prefer.

Tolerance levels found in DecAID for ponderosa pine/Douglas-fir habitats recent post fire were used to predict habitat "potential" across the planning area and as a comparison between alternatives. The densities fall within the 80 percent tolerance level for the white-headed woodpecker on 2% of the planning area, and 12% of the planning area for Lewis's woodpecker.

Table 3.22 Acres of Habitat of all Habitat Types by Tolerance Level by Species

Species	*Below 30 TL*		*30% TL*		*50% TL*		*80% TL*		*Total Acres**	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
White-headed Woodpecker	***4,981***	26%	***10,860***	57%	***2,781***	15%	***348***	2%	***18,971***	100%
Lewis's Woodpecker	***1,481***	8%	***5,191***	27%	***10,014***	53%	***2,286***	12%	***18,971***	100%

*Total does not include approximately 2,000 acres of the 21,000 acre project area where there currently is no data.

There are no tolerance levels available for the pygmy nuthatch.

Post harvest fuel loadings are projected to range from 10-15 tons/acre across the 3,100 acres of harvest units. These levels for ponderosa pine habitat convert to 1.8 to 2.7 percent down wood cover. As snags fall down wood would increase. Due to the pattern of clumps and leave areas of the harvest units, fire could be reintroduced and down wood cover would be high in clumps and pockets that could be protected. The broad distribution of treated units would provide some protection to untreated areas. See Fuels Section.

Alternative D

Direct and Indirect Effects

Alternative D removes snags from approximately 300 acres of formerly ponderosa pine habitat in the areas of 100% mortality. Removal of snags reduces the densities in 4% of this habitat. Post harvest 40% of the habitat type has snag densities that exceed 40 trees per acre (solid green on the chart). Snag retention strategies retain over 80% of the area with snag levels exceeding 12 snags per acre and nearly 70% of the area with 4 or more snags per acre over 20 inches dbh (open green line on chart). After 40 years the density ranges between 0-4 snags per acre, similar to Alternative A. At 100 years untreated areas would be similar to Alternative A; treated areas similar to Alternative B.

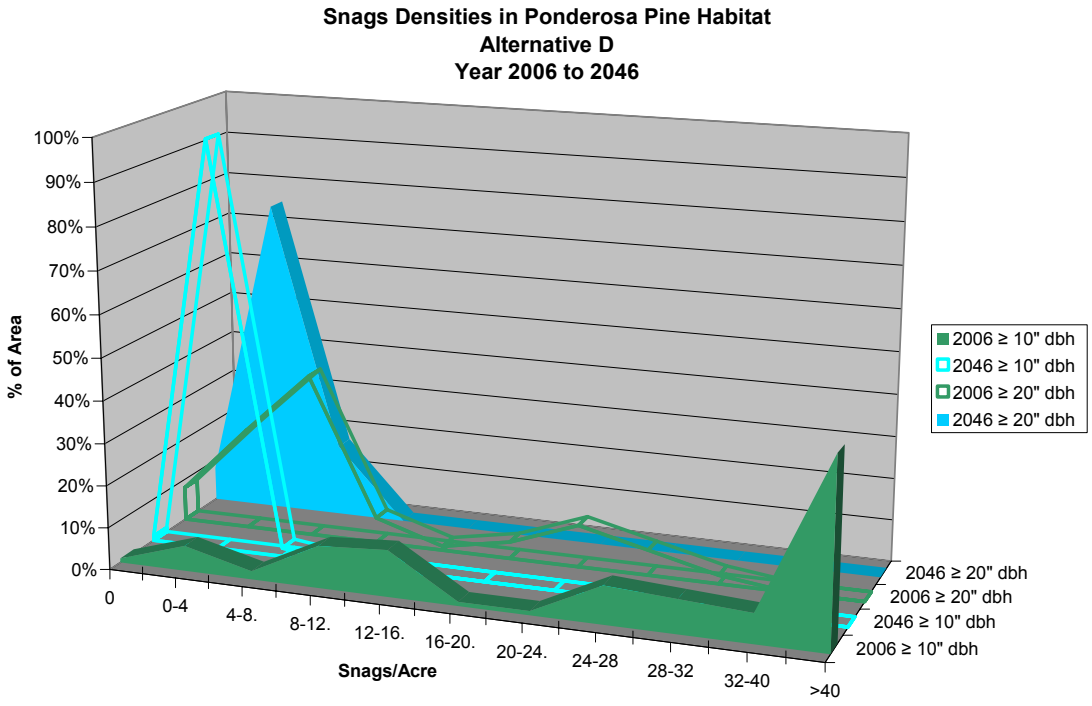


Figure 3.4 Snag Densities in Ponderosa Pine Habitat over Time, Alternative D

With the development of only 300 acres of habitat effects are very similar to Alternative A. There is no development of habitat within the LSR, just matrix and east of the NWFP lands. The densities fall within the 80 percent tolerance level for white-headed woodpeckers on 16% of the planning area, and 35% of the planning area for Lewis's woodpecker.

Table 3.23 Post Harvest Acres of Habitat by Tolerance Level by Species

Species	*Below 30 TL*		*30% TL*		*50% TL*		*80% TL*		*Total Acres**	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
White-headed Woodpecker	***4786***	25%	***6529***	35%	***4638***	25%	***2997***	16%	***18950***	100%
Lewis's Woodpecker	***1460***	8%	***4464***	24%	***6472***	34%	***6554***	35%	***18950***	100%

*Total does not include approximately 2,000 acres of the 21,000 acre project area where there currently is no data.

Post harvest fuel loadings are projected to range from 10-15 tons/acre across the 300 acres of harvest units. These levels for ponderosa pine habitat convert to 1.8 to 2.7 percent down wood cover. As snags fall down wood would increase. Due to the pattern of clumps and leave areas of the harvest units, fire could be reintroduced and down wood cover would be high in clumps and pockets that could be protected. Down wood levels across the remaining habitat would exceed historic levels. Similar to Alternative A it would take several burn cycles to return to historic fuel loading, potentially destroying developing habitat.

Alternative E

Direct and Indirect Effects

Alternative E removes snags from 1,800 acres of formerly ponderosa pine habitat in the areas of 100% mortality. Removal of snags reduces the densities in 22% of this habitat across the planning area. With a combination of low density clumps, high density leave areas and 78% of this habitat type untreated, post harvest distribution of snags has 43% of the habitat type exceeding 40 snags per acre (solid green on chart). After 40 years the density ranges between 0-4 snags per acre, similar to Alternative A (blue on chart). At 100 years, treated areas would be similar to Alternative B; untreated areas similar to Alternative A.

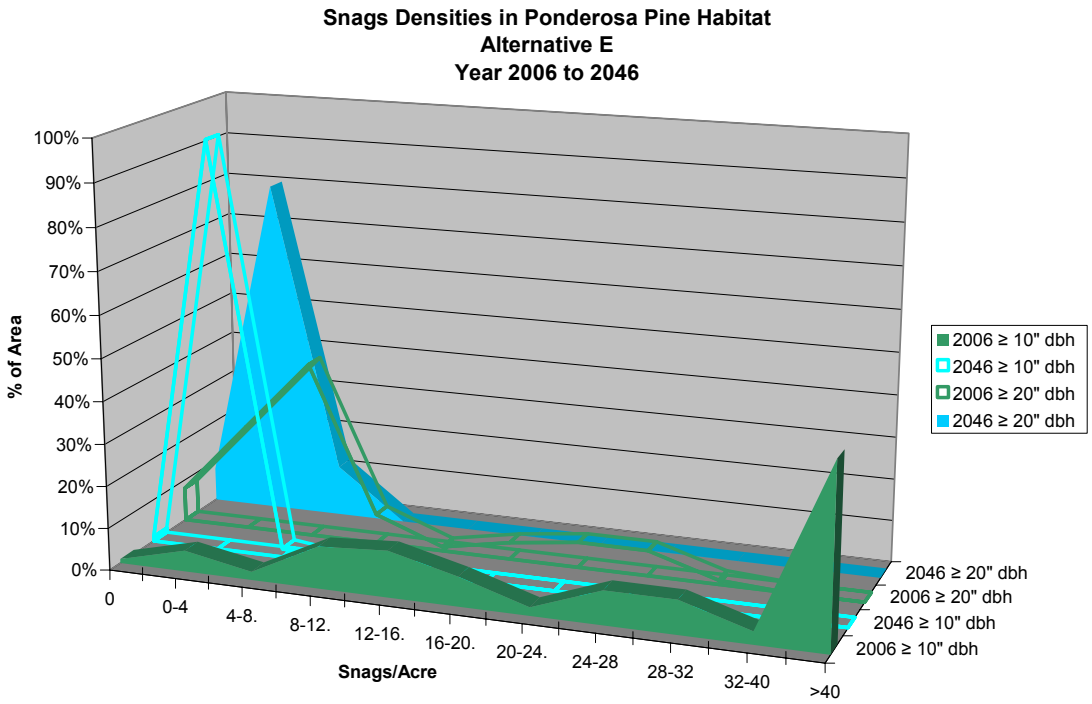


Figure 3.5 Snag Densities in Ponderosa Pine Habitat Over Time, Alternative E

Post harvest snag densities at the 80% tolerance level for the white-headed woodpecker would be present on 9% of the planning area, 25% of the area for Lewis's woodpecker.

Table 3.24 Post Harvest Acres of Habitat by Tolerance Level by Species

Species	*Below 30 TL*		*30% TL*		*50% TL*		*80% TL*		*Total Acres**	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
White-headed Woodpecker	***4649***	25%	***8629***	46%	***3978***	21%	***1694***	9%	***18950***	100%
Lewis's Woodpecker	***1460***	8%	***4423***	23%	***8393***	44%	***4675***	25%	***18950***	100%

*Total does not include approximately 2,000 acres of the 21,000 acre project area where there currently is no data.

Down wood levels in this alternative would range between 1.8 and 2.7 percent cover on 1,800 acres within this habitat area, allowing for the reintroduction and maintenance of stands with fire. The remaining 3,000 acres would exceed historic levels.

Cumulative Effects Common to All Alternatives

Habitat reduction for the most part took place with the fire. This habitat type historically had frequent fires, low intensity burns with individual tree or patch mortality. The white-headed woodpecker, Lewis's woodpecker and pygmy nuthatch do not benefit from large stand replacement events where there are thousands of contiguous acres of 100% mortality. Habitat created by the underburn or mixed intensity area remains untreated. Habitat for the white-headed woodpecker and pygmy nuthatch would remain limited to these areas in the short term. Because the woodpecker guild is a Forest Plan Management Indicator Species (MIS), and the white-headed woodpecker is a migratory focal species, and a bird of conservation concern (BCC) as well as a NWFP Survey and Manage Species (S&M) manipulation of any ponderosa pine dominated habitat across the district would consider the needs of these species.

Outside the planning area nearly 5,000 acres within the LSR (MSAs F, G, BB), 6,000 acres in matrix and 70,000 acres east of the NWFP provide potential habitat for these species. Increases in habitat will occur where management activities reduce dense multi-story ponderosa pine stands to open stands. The fire occurred in the former Seven Buttes and Seven Buttes Return analysis areas. Seven Buttes and Seven Buttes Return looked at balancing ponderosa pine in an open single story condition and multi-story condition across the planning area. These analyses proposed development of approximately 4,000 acres of single story ponderosa pine habitat outside of the fire area (approximately 700 acres from Seven Buttes and 3,300 from Seven Buttes Return). Nearly half of the acres of both projects have been completed with timber sales. All existing snags in these sales were/are to be left standing except where they posed a hazard to logging. In addition, to provide future snags, trees damaged during logging would be left on site instead of felled. Fuels reduction activities, such as prescribed burning, post harvest will also create snags within the units. With the healthy forest initiative, and an emphasis on the district to put fire back into ponderosa pine habitat, there is likely to be a continued increase in habitat for these species, as well as the Lewis woodpecker, across the district.

Mixed Conifer Habitats – Williamson Sapsucker, Pileated Woodpecker

Alternative A –No Action

Direct and Indirect Effects

Habitat for the Williamson sapsucker and pileated woodpecker would remain limited over the project area for a long time. Development of large tree dense old growth would occur over time as succession progressed. The large snag component created by the fire would decline over the years providing the soft decayed wood these species prefer. Large snag recruitment would evolve with the development of the older stand once the stands progressed from lodgepole pine to mixed conifer species estimated to occur in 150-200 years. Approximately 89% of the area has snag densities that exceed 12 snags per acres (solid green on chart). Snag levels drop over 40 years from 30% of the area exceeding 60 snags to 98% of the area with snag densities between 0.1and 6 snags per acre (open blue line on chart). With this alternative there is still 7% of the area with snags greater than 20 inch dbh in densities greater than 6 per acre. At one hundred years these areas would be dominated by lodgepole pine, there would be very little recruitment of snags over 10 inches dbh.

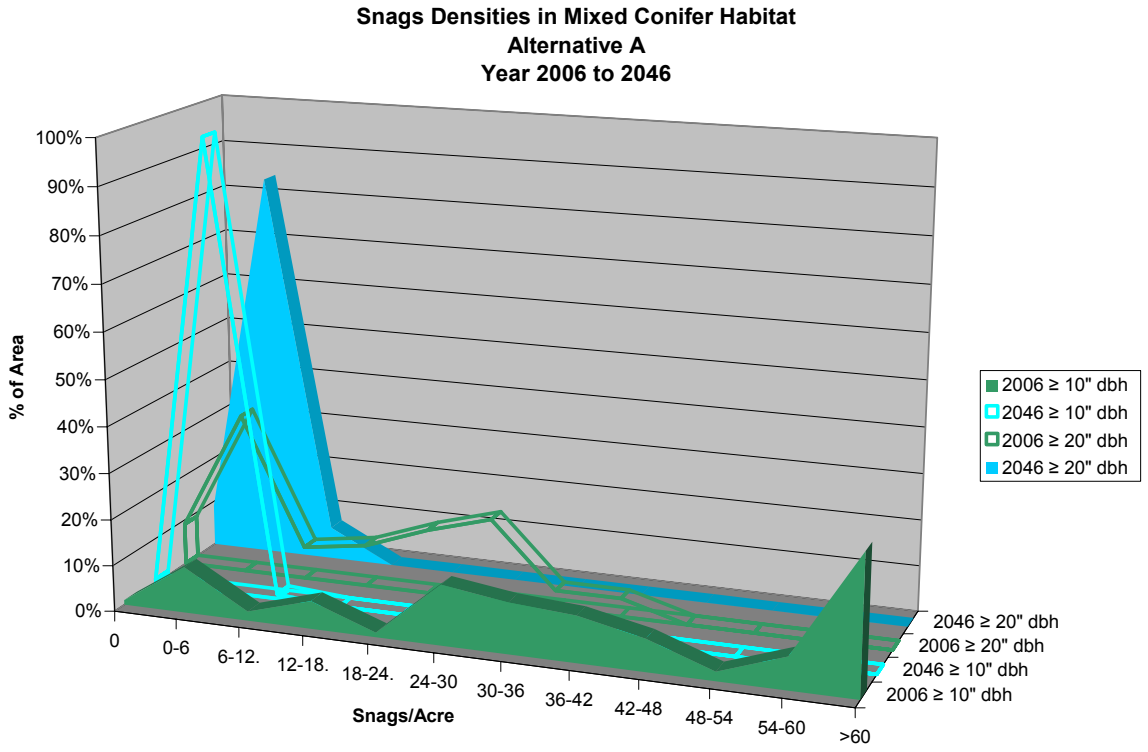


Figure 3.6 Snag Densities in Mixed Conifer Habitat over Time, Alternative A

There currently are no recent post fire tolerance levels in DecAID for Williamson and pileated woodpecker. Williamson and pileated woodpeckers have not shown up in any of the post fire studies. While snag levels may be high across the planning area with this alternative that does not mean there would be habitat for those two species. Foraging habitat would be present but it is questionable if nesting habitat would be available.

Down wood becomes an important source of food for pileated woodpeckers as it decays and supports carpenter ant and other insect populations. DecAID found levels of down wood used by pileated woodpeckers (PIWO) generally exceeded what was found across the landscape in the CVS plots. Down wood percent cover exceeding 5.1 (27 tons/acre) provides habitat at the 80% tolerance levels. This level would be found across the mixed conifer habitat type.

Alternative B and C

Direct and Indirect Effects

Alternative B and C remove snags from 3,200 acres of formerly mixed conifer habitat in the areas of 100% mortality. Removal of snags reduces the densities in this habitat across the planning area. With a combination of low density clumps, high density leave areas and 62% of this habitat type untreated, post harvest distribution of snags has 85% of the area with snag levels exceeding 12 snags per acre (solid green on chart) and 35% of the area exceeding 6 trees per acre over 20" dbh (open green line on following chart). After 40 years the density ranges between 0-6 snags per acre, similar to Alternative A (open blue on chart), except there would not be any snags over

20 inch dbh at densities greater than 6 per acre (solid blue on chart). At 100 years the stands average 14" dbh. Recruitment of snags 20" and larger would begin.

Treated areas would recover mixed conifer habitats to the point of recruiting snags 14 inches dbh by age 100 post harvest. Ponderosa pine and Douglas-fir would be dominating these areas. Between 40-60 years post fire, fire would be used in a portion of the stands to maintain open grown structure for eagles. The remaining stands would be allowed to become denser and begin to develop decadence for these species as well as the spotted owl.

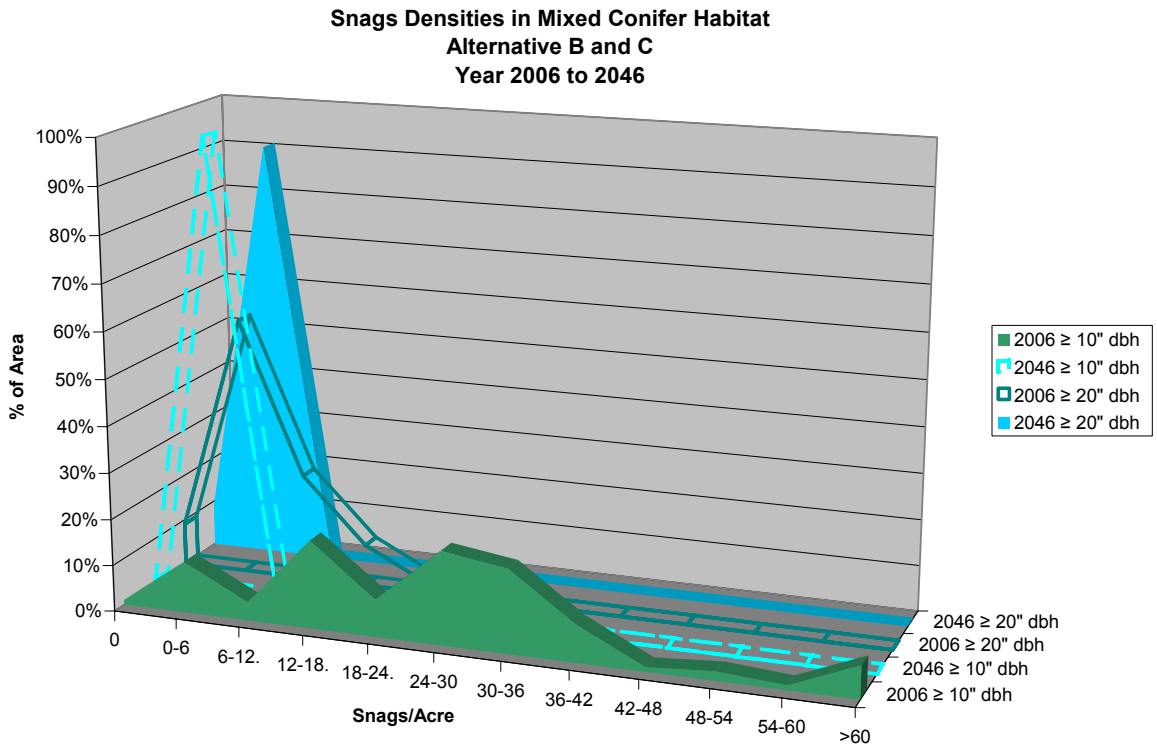


Figure 3.7 Snag Densities in Mixed Conifer Habitat over Time, Alternatives B and C

Down wood levels would exceed 80% tolerance levels on 62% of this habitat type. It would occur at the 30% level or 4% down wood cover (20 tons/acre) in pockets and clumps on the remaining 3,100 acres.

Alternative D

Direct and Indirect Effects

Alternative D reduces snags from 700 acres of formerly mixed conifer habitat in the areas of 100% mortality. Removal of snags reduces the densities in this habitat across the planning area. With a combination of low density clumps, high density leave areas and 87% of this habitat type untreated, post harvest distribution of snags has 86% of the area with snag levels exceeding 12 snags per acre (solid green on chart) and 54% of the area have densities over 6 trees per acre of snags greater than 20 inch dbh (open green line). After 40 years the density ranges between 0-4 snags per acre, similar to Alternative A (open blue line), except 6% of the area would have snags greater than 20 inch dbh at densities greater than 6 per acre (solid blue on chart).

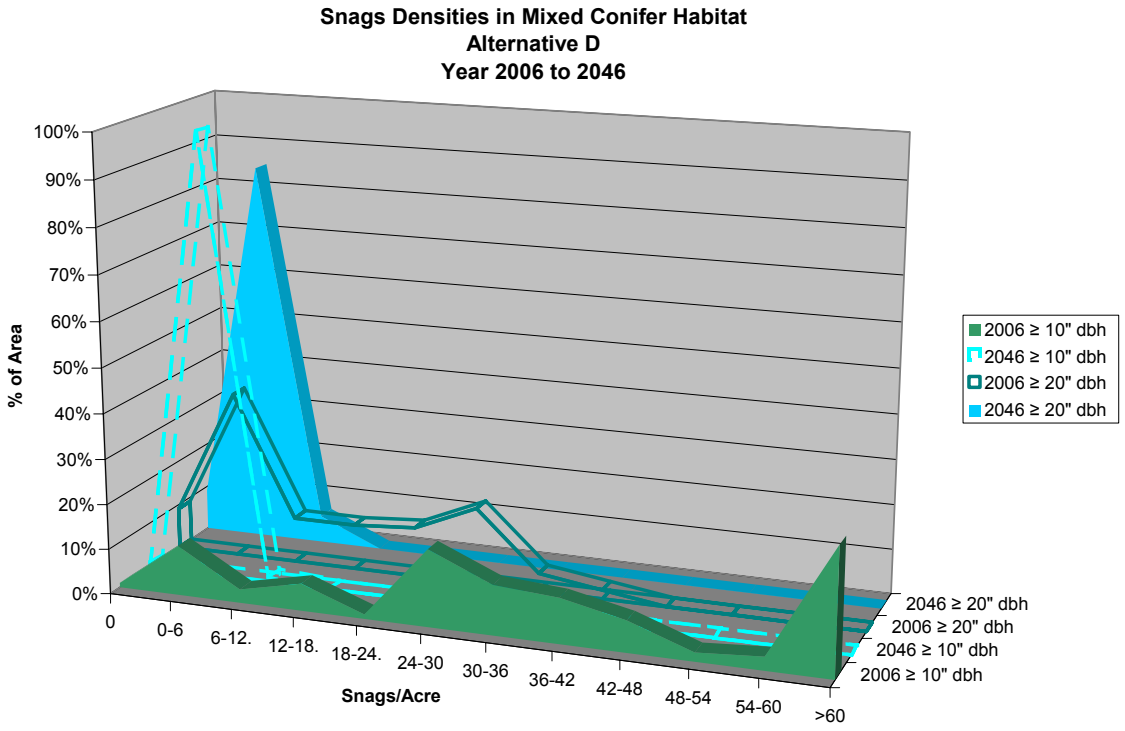


Figure 3.8 Snag Densities in Mixed Conifer Habitat over Time, Alternative D

Down wood levels would remain at 80% tolerance levels on 87% of this habitat type. It would occur at the 30% tolerance level (20 tons/acre) over the remaining 13% of the area.

Alternative E

Direct and Indirect Effects

Alternative E reduces snags from 1600 acres of formerly mixed conifer habitat in the areas of 100% mortality. Removal of snags reduces the densities in this habitat across the planning area. With a combination of low density clumps, high density leave areas and 81% of this habitat type untreated, post harvest distribution of snags has 87% of the area with snag levels exceeding 12 snags per acre greater than 10 inch dbh and 43% of the area exceeding 4 trees per acre over 20 inch dbh. After 40 years the density ranges between 0-4 snags per acre, similar to Alternative A, except 4% of the area has snags greater than 20 inch dbh at densities greater than 6 per acre.

Treated areas would recover mixed conifer habitats to the point of recruiting snags 14 inches dbh at least by age 100 post harvest. Ponderosa pine and Douglas-fir would be dominating these areas. Between 40-60 years post fire, fire would be used in a portion of the stands to maintain open grown structure for eagles and spotted owls. The remaining stands would be allowed to become dense and begin to develop decadence for these species as well as the spotted owl.

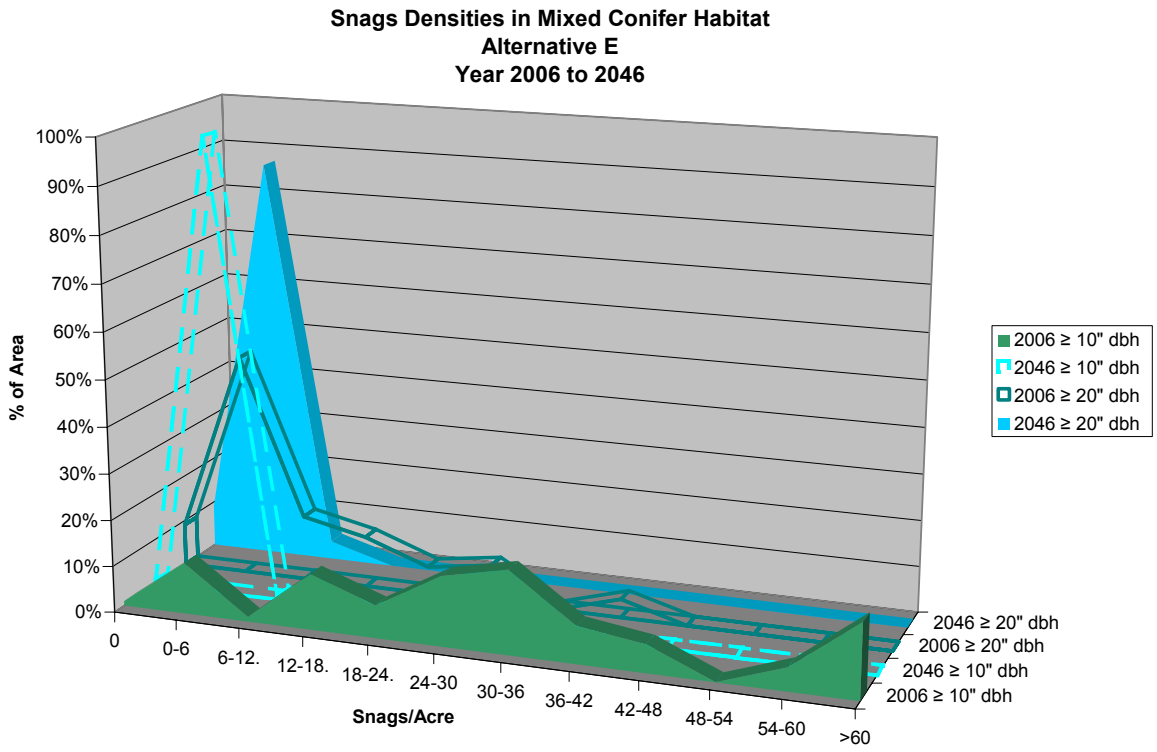


Figure 3.9 Snag Densities in Mixed Conifer Habitat Over Time, Alternative E

Down wood levels would remain at 80% tolerance levels for the pileated woodpecker on 81% of the area. Over 20% of the mixed conifer habitat would provide feeding opportunities in pockets and clumps at the 30% tolerance level.

Cumulative Effects

Habitat reduction for the most part took place with the fire. Mixed conifer habitat type historically had a moderate fire frequency of mixed intensity burns with patch or stand mortality. The Williamson sapsucker and pileated woodpecker do not benefit from large stand replacement events where there are thousands of contiguous acres of 100% mortality and very little mosaic. On Crescent Ranger District potential habitat for pileated woodpecker and the Williamson sapsucker (outside of the fire area) would be managed in the LSR on approximately 13,500 acres (in MSAs C, E, K, P, S, T, V, W, AA), 33,000 acres in matrix, 16,000 acres in administratively or congressionally withdrawn lands, and 14,000 acres east of the NWFP. Habitat for these species will continue to be managed on sites that have the potential to sustain high densities of trees.

There continues to be high risk of catastrophic loss of large tree habitat in dense mixed conifer stands across the district. Seven Buttes and Seven Buttes Return projects strove to reduce risk across the landscape by creating a mosaic of conditions over a large area. Reduction in habitat will occur where treatments move drier mixed conifer multi-storied stands dominated by large ponderosa pine to single storied stands. Multi-storied treatments would remain habitat and maintain it longer over time as the prescriptions improve the health and vigor of the overstory tree species as well as maintain scattered dense thickets of understory trees and shrubs.

Seven Buttes sales treated 6,000 acres over the last 10 years, nearly 5,000 acres outside the fire area. These treatments included 700 acres of conversions to single-story stands and 5,300 acres of maintenance of multi-storied stands. Approximately 4,600 acres of understory thinning in the Seven Buttes Return were planned; 3,300 acres of conversion to single-story, 1,300 acres of maintenance of multi-story. Seven Buttes has been fully implemented and

approximately 50% of Seven Buttes Return has been implemented. All existing snags in these sales were/are to be left standing except where they posed a hazard to logging. In addition, to provide future snags, trees damaged during logging would be left on site instead of felled. Fuels reduction post harvest will also create a limited number of snags within the units. Because of the changed conditions, an analysis of the remaining Seven Buttes Return potential treatments will be completed. That analysis would determine how much if any treatment in this habitat would be prudent at this time.

Lodgepole Pine Habitats – Black-backed Woodpecker

Effects Common to All Alternatives, Including No Action

There is no salvage proposed within lodgepole pine habitat types, including the 2,420 acres within the LSR. Because black-backed woodpeckers can take advantage of insects in moderate and high intensity burn areas, the 15,500 acres of created habitat is discussed in this section as black-backed woodpecker habitat regardless of habitat type and management allocation.

Varying quality of habitat for the black-backed woodpecker would continue to be provided over 15,500 acres of the fire area, for approximately the next 1-5 years (Sallabanks et al 2001, Saab and Dudley 1998). Development of lodgepole pine to the size and density where it would again host bark beetle populations would be expected to occur over 60-100 years. Increased habitat due to the pioneer nature of lodgepole pine into former mixed conifer and ponderosa pine habitats would occur to various degrees across the fire area.

Areas not treated will continue to provide habitat for the black-backed woodpecker for approximately 5 years post-fire (Saab and Dudley 1998). These areas have the potential to increase black-backed populations during that timeframe.

Alternative A –No Action

Direct and Indirect Effects

Alternative A does not remove any snags from lodgepole habitat, nor does it remove snags from any other habitat type. Habitat would be available at varying levels across 15,500 acres of moderate and high intensity burned areas in the project area. Approximately 15% of the project area would provide habitat at the 30% tolerance level, 21% at the 50% tolerance level, and 1% at the 80%. These levels may appear low for a post fire area with no harvest. However densities represented in DecAID for the black-backed woodpecker in recent post fire are 62.2 for the 30% tolerance level, 88.3 for the 50% tolerance level and 126.1 for the 80% tolerance level. There are several reasons for the low densities: 1. Lodgepole pine habitat in this area was already in a state of decline and falling down. 2. While the ponderosa pine and mixed conifer types had very dense understories, they also had a large number of large trees. The large trees limited the area available for small trees, so high densities of trees (those greater than 126/acre) were on very few acres.

Table 3.25 Post Harvest Acres of Habitat in All Habitat Types by Tolerance Level, Alternative A

Species	Management Area	Below 30 TL		30% TL		50% TL		80% TL		Total Acres	
		Acres	% Project Area	Acres	% Area	Acres	% Area	Acres	% Area	Acres	% Area
Black-back Woodpecker	EAST	1,265	7%	51	9%	0	0%	0	0%	1,316	7%
	LSR	5,950	31%	1,848	10%	3,133	17%	206	1%	11,137	59%
	MAT	4,435	23%	938	5%	783	4%	39	0%	6,195	33%
	AWD	302	2%	0	0%	0	0%	0	0%	302	2%
		11,952	**63%**	**2,837**	**15%**	**3,916**	**21%**	**246**	**1%**	**18,950**	**100%**

Habitat within the lodgepole habitat type post harvest (2006) is limited to a little over 5% of the area that exceed 60 snags per acre (solid green). Pockets with dense thickets occur across this habitat type, but are not accounted for as snags levels are determined as a stand average.

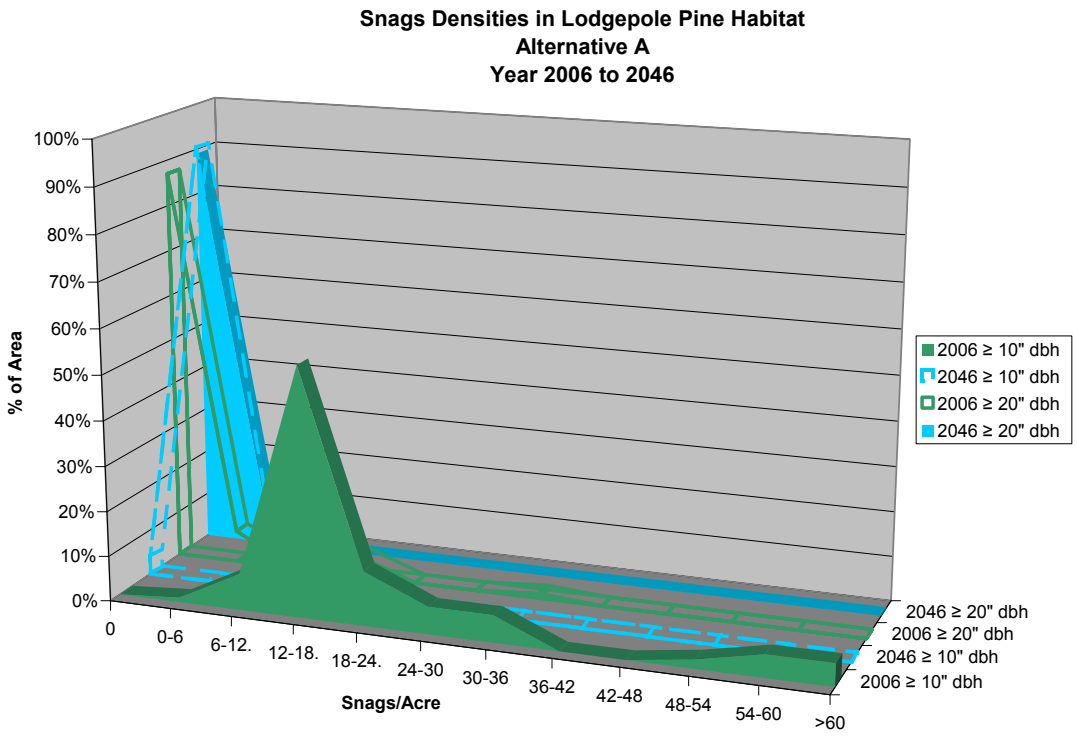


Figure 3.10 Lodgepole Snag Densities in the Project Area Over Time, Alternative A

There are few snags over 20 inches in this habitat type, 0-6 snags per acre (open green). Because of the small diameters in lodgepole pine snag densities drop quickly. At 40 years (2046) nearly 100% of the lodgepole pine habitat had 0-6 snags per acre (blue).

Alternative B and C

Direct and Indirect Effects

Alternative B and C reduces snags on 6,355 acres, reducing available short-term habitat for the black-back woodpecker more than any of the other alternatives. Habitat would be available at varying levels on 9,145 acres and in pockets on 953 acres of retention areas. By DecAid standards, either of these alternatives would reduce habitat to 4% of the project area providing habitat at the 30% tolerance level, 4% at the 50% tolerance level and 0.2% at the 80% level, a drop from 246 acres providing habitat at the 80% tolerance level to 31 acres.

Table 3.26 Post Harvest Acres of Habitat in All Habitat Types by Tolerance Level, Alternatives B and C

Species	Management Area	Below 30 TL		30% TL		50% TL		80% TL		Total Acres	
		Acres	% Project Area	Acres	% Area	Acres	% Area	Acres	% Area	Acres	% Area
Black-back Woodpecker	AWD	301.5	2%	0	0%	0	0%	0	0%	301.546	1.6%
	EAST	1190.6	6%	51	0%	0	0%	0	0%	121.644	6.6%
	LSR	10321.6	55%	444.8	2%	458.8	2%	30.9	0.2 %	11256.109	59.4%
	MAT	5504.9	29%	286.6	2%	359.4	2%	0	0%	6150.864	32.5%
		17318.6	**91%**	**782.4**	**4%**	**818.2**	**4%**	**30.9**	**.2%**	**18950.163**	**100%**

Given the low number of acres providing for blacked back woodpeckers, it would appear preservation of every bit of habitat within the fire would be necessary. However, there are a number of reasons not to:

1. DecAid numbers do not accurately reflect use in larger timber types;
2. The number of acres of lodgepole habitat outside the project area;
3. The need to provide dispersal habitat for northern spotted owls to avoid vacancy in existing owl territories;
4. The purpose of the project to restoring the area to more natural vegetation and fuel loadings;
5. The need to grow large trees more quickly, by reducing fuel loadings now while it cost effective to do so, planting trees without further delay, to provide that habitat and the ability to maintain those stands with the reintroduction of fire at a later date.

There are approximately 45 acres of fuels reduction around Davis East Campground and 100 acres of fuels treatments within the lodgepole habitat type reducing snag levels slightly.

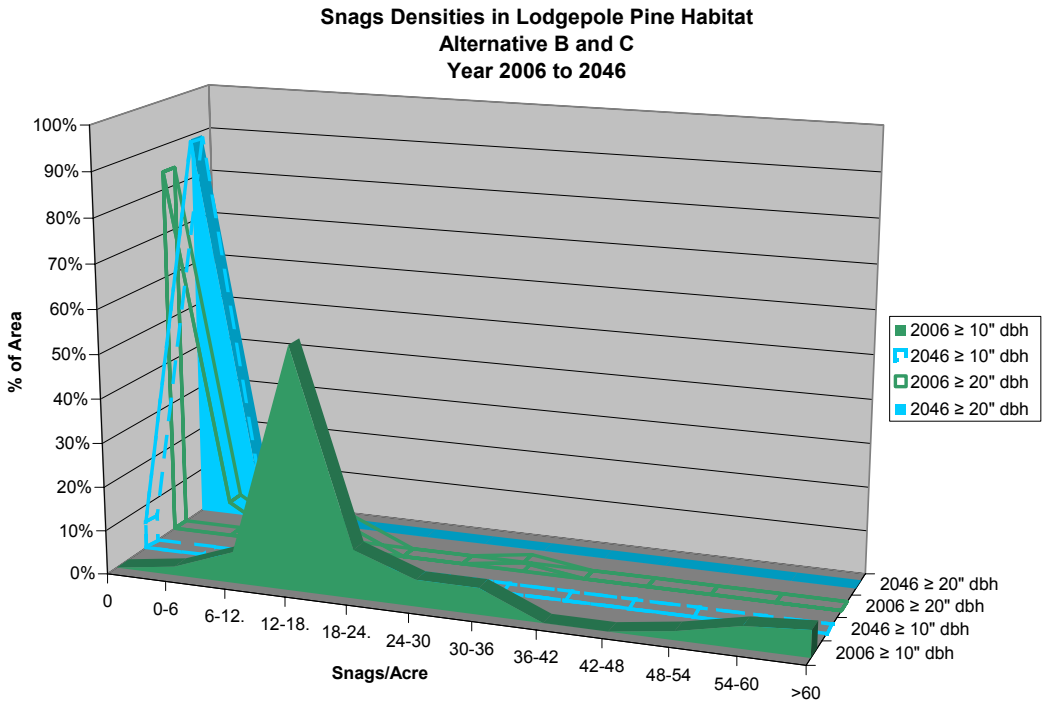


Figure 3.11 Snag Densities in the Project Area over Time, Alternatives B and C

Alternative D

Direct and Indirect Effects

Alternative D reduces snag levels on 1,045 acres, reducing available short-term habitat for the black-back woodpecker. Habitat would be available at varying levels on 14,455 acres and in pockets on 157 acres of retention areas. This alternative is very similar to Alternative A because it treats very little of the project area, and little habitat is provided at the 80% tolerance level. Approximately 11% of the project area would provide habitat at the 30% tolerance level, 19% at the 50% tolerance level, and 1% at the 80%.

Table 3.27 Post Harvest Acres of Habitat in All Habitat Types by Tolerance Level

Species	Management Area	Below 30 TL		30% TL		50% TL		80% TL		Total Acres	
		Acres	% Project Area	Acres	% Area	Acres	% Area	Acres	% Area	Acres	% Area
Black-back Woodpecker	AWD	301.5	2%	0	0%	0	0%	0	0%	301.546	2%
	EAST	1190.6	6%	51	0%	0	0%	0	0%	1241.644	7%
	LSR	6068.6	32%	1848	10%	3133.2	17%	206.3	1%	11256.109	59%
	MAT	5413.4	29%	242.6	1%	455.6	2%	39.3	0%	6150.864	33%
		12974.1	**69%**	**2141.6**	**11%**	**3588.8**	**19%**	**245.6**	**1%**	**18950.163**	**100%**

Snag fall down rates are similar to all other alternatives; fuel treatments are common to all action alternatives.

Snag densities over time in lodgepole pine are the same as Alternative A.

Alternative E

Direct and Indirect Effects

Alternative E reduces snag levels on 3,450 acres, reducing available short-term habitat for the black-back woodpecker. Habitat would be available at varying levels on 12,050 acres and in pockets on 517 acres of retention areas. Approximately 8% of the project area would provide habitat at the 30% tolerance level, 12% at the 50% tolerance level, and 0.8% at the 80%.

Table 3.28 Post Harvest Acres of Habitat in All Habitat Types by Tolerance Level

Species	Management Area	Below 30 TL		30% TL		50% TL		80% TL		Total Acres	
		Acres	% Project Area	Acres	% Area	Acres	% Area	Acres	% Area	Acres	% Area
Black-back Woodpecker	AWD	4958.1	26%	432.5	2%	721	4%	39.3	0.2%	6150.864	33%
	EAST	301.5	2%	0	0%	0	0%	0	0%	301.546	2%
	LSR	1190.6	6%	51	0%	0	0%	0	0%	1241.644	7%
	MAT	8468.3	45%	1100.6	6%	1582.1	8%	105.2	0.6%	11256.109	59%
		14918.5	**79%**	**1584.4**	**8%**	**2303.1**	**12%**	**144.5**	**0.8%**	**18950.16**	**100%**

Habitat reduction over time takes place the same as the other alternatives.

Cumulative Effects

Lodgepole pine habitat would continue to be managed for black-backed woodpeckers on 10,000 acres within the LSR (MSA A, B, D, I, U, X, Y, Z, and AA) outside the project area. Seven Buttes and Seven Buttes Return proposed treatment in 2000 acres of lodgepole habitat. A decrease in black-backed woodpecker habitat will occur as density management of mixed conifer stands and lodgepole pine stands across the district will continue where stands pose a fire hazard in interface areas with campgrounds and private land. Habitat for black-backed woodpeckers would be provided in a cyclic basis across approximately 141,500 acres of lodgepole pine habitat across the district and 567,086 acres across the forest would remain in various stages of bug infection, decline and renewal.

Complex habitats – Flammulated owl, American marten, Mountain bluebird, Northern flicker, Olive-sided flycatcher

Alternative A

Direct and Indirect Effects

Habitat for the olive-sided flycatcher, mountain bluebird and northern flicker would be provided across the landscape. Increasing populations would be expected on 15,500 acres of 100% mortality for the next 1-5 years for the olive-sided flycatcher (Sallabanks et al 2001, Saab and Dudley1998) and up to 15 years for the mountain

bluebird (O'Neil 2001). In approximately 150-200 years, as succession progresses, snags will fall, and openings would grow in. The project area would be dominated by lodgepole pine habitat. Habitat for American marten and flammulated owl will continue to be limited to approximately 4,000 acres of unburned or underburned habitat within the planning area until succession progresses, in approximately 150-200 years, to the point of providing large green trees and canopy closures preferred by these species. Snag densities over the landscape are discussed by habitat type and will not be repeated here.

DecAID does not provide snag density tolerance levels for the flammulated owl or the olive-sided flycatcher, or at all levels for American marten or cavity nesting birds. The "generic" cavity nesting birds category, along with the mountain bluebird should give an indication of trend in habitat for the olive-sided flycatcher and flammulated owl.

Using DecAID tolerance levels this alternative provides snag densities at the 80% tolerance level for hairy woodpeckers on 23% of the project area, on 5% of the project area for mountain bluebirds and on 2% of the project area for northern flicker. Snag densities meet or exceed 50% tolerance level on 70% of the area for cavity nesting birds and 80% of the area for American marten.

Table 3.29 Acres of Habitat by Tolerance Level and Species, Alternative A

Species	*Below 30 TL*		*30% TL*		*50% TL*		*80% TL*	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
Hairy Woodpecker	1763.6	9.30%	7486.7	39.50%	5337.4	28.20%	4369.2	23.00%
Mountain Bluebird	1193.8	6.30%	4651.1	24.50%	12210.5	64.40%	901.8	4.80%
Northern Flicker	4944	26.10%	7434.3	39.20%	6120.2	32.30%	458.4	2.40%
Cavity Nesting Birds					13289.1	70.10%		
American Marten					15160.4	80.00%		

Alternative B and C

Alternatives B and C removes snags from 6,355 acres, it is also reforesting 8,400 acres including the salvage units. Over the short term there is a reduction in habitat for the hairy woodpecker and mountain bluebird and northern flicker and potentially the olive-sided flycatcher. Over the long term there is additional habitat being developed. Habitat reduction for cavity nesting birds as a group and American marten is minimal.

Table 3.30 Acres of Habitat by Tolerance Level and Species , Alternative B

Species	*Below 30 TL*		*30% TL*		*50% TL*		*80% TL*	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
Hairy woodpecker	***1829.6***	9.60%	***11684.7***	61.60%	***4543.6***	24.00%	***913***	4.80%
Mountain bluebird	***1200.8***	6.30%	***6673***	35.20%	***10941.6***	57.70%	***155.6***	0.80%
Northern flicker	***4974.1***	26.20%	***12825.4***	67.60%	***1171.4***	6.20%	***0***	0.00%
Cavity nesting birds					***13220.8***	69.70%		
American marten					*15123.5*	79.70%		

Because of the additional helicopter logging in Alternative C, there is a slight difference in the number of smaller diameter snags left. Increase the area at the 80% and 50% tolerance levels for mountain bluebird, and the 50% tolerance level for the hairy woodpecker.

Table 3.31 Acres of Habitat by Tolerance level and Species, Alternative C

Species	*Below 30 TL*		*30% TL*		*50% TL*		*80% TL*	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
Hairy woodpecker	***1808.9***	9.50%	***11478.1***	60.60%	***4750.1***	25.10%	***913***	4.80%
Mountain bluebird	***1200.8***	6.30%	***6328.8***	33.40%	***11164.1***	58.90%	***256.8***	1.40%
Northern flicker	***4974.1***	26.20%	***12909.8***	68.10%	***1066.3***	5.60%	***0***	0.00%
Cavity nesting birds					***13200.1***	69.70%		
American marten					***15123.5***	79.80%		

Alternative D

Alternative D removes snags from 1,045 acres, it is also reforesting 2,030 acres including the salvage units. Over the short term there is a reduction in habitat for the hairy woodpecker and mountain bluebird and northern flicker and potentially the olive-sided flycatcher. Over the long term there is additional habitat being developed in the matrix and east of the NWFP lands. Habitat reduction for cavity nesting birds as a group and American marten is minimal.

Habitat at the 80% tolerance level is reduced for the hairy woodpecker, mountain bluebird and northern flicker. There is no reduction of habitat at the 50% or greater tolerance level for cavity nesting birds or American marten.

Table 3.32 Acres of Habitat by Tolerance Level by Species, Alternative D

Species	*Below 30 TL*		*30% TL*		*50% TL*		*80% TL*	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
Hairy woodpecker	***1770.5***	9.30%	***8223.6***	43.40%	***4980.3***	26.30%	***3975.7***	21.00%
Mountain bluebird	***1200.8***	6.30%	***4930.1***	26.00%	***12183***	64.30%	***636.4***	3.40%
Northern flicker	***4937.2***	26.10%	***8477.4***	44.70%	***5342.5***	28.20%	***193***	1.00%
Cavity nesting birds					***13289.1***	70.10%		
American marten					***15160.4***	80.00%		

Alternative E

Alternative E removes snags from 3,450 acres, it is also reforesting 4,070 acres including the salvage units. Over the short term there is a reduction in habitat for the hairy woodpecker and mountain bluebird and northern flicker and potentially the olive-sided flycatcher. Over the long term there is additional habitat being developed in the matrix and east of the NWFP lands. Habitat reduction for cavity nesting birds as a group and American marten is minimal.

Habitat at the 80% tolerance level is reduced for the hairy woodpecker, mountain blue bird and northern flicker. There is a slight reduction of habitat at the 50% or greater tolerance level for cavity nesting birds or American marten.

Table 3.33 Acres of Habitat by Tolerance Level by Species Alternative E

Species	Below 30 TL		30% TL		50% TL		80% TL	
	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
Hairy woodpecker	1770.5	9.30%	9877.4	52.10%	4713.4	24.90%	2588.8	13.70%
Mountain bluebird	1200.8	6.30%	5442.3	28.70%	11583.9	61.10%	723.3	3.80%
Northern flicker	4974.1	26.20%	10320	54.50%	3197.8	16.90%	458.4	2.40%
Cavity nesting birds					13252.2	69.90%		
American marten					15123.5	79.80%		

Cumulative Effects

Habitat for all these species will be present in shifting patterns. Management for these species would continue across the LSR as emphasis for retaining large trees, and abundance of snags and down wood continues. Habitat needs and considerations would be included in any management as all of these species are part of the management indicator list of the Deschutes forest plan, bird of conservation concern, or migratory focal species. Single and multi-storied treatments prescribed in Seven Buttes and Seven Buttes Return promote the health and vigor of large trees, provides diversity across the landscape with open and dense stands, scattered dense thickets and shrubs. Less than optimal fire habitats for the olive-sided flycatcher would occur at forest edges.

Consistency with Various Standards and Guidelines, Management Recommendations, Northwest Forest Plan Implementation Strategy and Deschutes National Forest Wildlife Tree and Log Strategy

White-headed woodpecker, Black-backed woodpecker, Pygmy nuthatch, and Flammulated owl.

The Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer and other Mitigation measures Standards and Guidelines (January 2001) on Standards and Guidelines page 34 states:

> " Snags over 20 inches dbh may be marked for cutting only after retaining the best available snags (considering size, longevity, etc.) in sufficient numbers to meet 100 percent of the potential population levels of these four species."

The 2001 amendment puts those levels for white-headed woodpeckers at 0.6 snags per acre at least 15 inch dbh, black-backed woodpecker at 0.12 snags per acre at least 17 inch dbh. Meeting standards for white-headed woodpecker was presumed in the amendment to provide for the pygmy nuthatch since they share the same habitat.

Flammulated owls utilize cavities occurring naturally or created by woodpeckers. The 2001 amendment assumed that standards and guidelines for snags and green-tree replacements for woodpeckers and other primary cavity nesting species in existing National Land and resource Management Plans would provide for flammulated owls. The 2001 amendment also states that provision must be additive, "Provisions of snags for other cavity-nesting species, including primary cavity nesters, must be added to the requirements for these two woodpecker species (black-backed and white-headed woodpeckers)."

The Deschutes National Forest developed their Wildlife Tree and Log Implementation Strategy to provide for various levels of percent populations levels. It includes adding the various woodpeckers together by habitat types. These standards call for 3.87 snags/acre in ponderosa pine, and 4.05 snags per acre in mixed conifer (adding in black-backed from NWFP), with 0.6 snags/acre greater than 20 inches dbh.

All action alternatives exceed these standards. Within the NWFP lands leaving 2-8 snags per acre in ponderosa pine habitats including all 36 inch and larger dbh trees, as well the associated 15% retention areas. Within the NWFP in mixed conifer habitats snags to be left are 12 snags/acre including all 36 inch and larger dbh trees, as well as the associated 15% retention. Minimum diameters range from 12-20 inches. In addition small diameter snags 10-14 inches not treated with fuels treatments would also be left in units. Snag densities in the 15% retention areas average 125 snags per acre in the 10 to 20 inches dbh category, 17 snags per acre in the 20 to 36 inches category and 3 snags per acre in the 36 inches dbh and above category.

In addition the action alternatives propose treatment to speed recovery and growth of green tree habitat and eventual snag recruitment.

Regional Forester's Eastside Forest Plan Amendment #2 (Eastside Screens)

Eastside screens calls for the retention of all green trees ≥ 21 inches dbh, and management for primary cavity excavators at 100 percent potential population within each unit as determined by the National Forests Land and Resource Management Plans. There is no harvest of green trees proposed, fuels treatments thin small diameter material. Snag levels in eastside units leave 8 snags per acre ≥20 inches dbh in addition to those smaller diameter snags 10-14 that are not treated with fuels treatments. In addition the action alternatives propose treatment to speed recovery and growth of green tree habitat and eventual snag recruitment.

Davis Late Successional Reserve Analysis

The Davis LSR calls for retention of 3 to 9 snags per acre 12 to 20 inch dbh and 0.75 to 2 snags per acre greater than 20 inches dbh within mixed conifer plant association groups in areas being managed for climatic climax; and 1 to 5 snags per acre greater than 25 inches dbh in areas being managed for fire climax. In ponderosa pine plant association groups areas managed for climatic climax are to manage for 0.5 to 3 snags per acre 18 to 28 inches dbh and 0.25 to 1.5 snags per acre greater than 28 inches dbh; and in fire climax managed areas 1-5 snags greater than 25 inches dbh.

The proposed snag retention strategy exceeds these guidelines.

Comparison of Alternatives

Post harvest there is a great deal of difference when looking at the distribution of snags across the project area. After 40 years there is very little difference. Only the mixed conifer habitat type is discussed and displayed. Trends in snag distribution in ponderosa pine habitats follow a similar pattern. In lodgepole pine habitat alternatives are virtually the same with only 30 acres receiving fuel treatments in the action alternatives.

Post harvest snag levels exceed DecAID baselines for all alternatives. Alternatives A (dark blue) and D (light blue) provide the greatest density of snags over a greater percentage of the area. In alternatives B/C (burgundy) and E (green) salvage of snags reduces densities on portions of the area, increasing the area that has moderately high levels of snags 18-36 snags per acre, and less in the high levels (greater than 48 snags per acre). At 40 years post harvest the alternatives vary only by 1 or 2% in snags greater than 6 snags per acre. The results are similar when comparing distribution of snags 20 inch dbh and greater between alternatives. Where there are greater numbers "post harvest" in alternatives A and E and only 1-2% difference 40 years post harvest (see charts following page).

DecAID looks at species habitat needs through tolerance levels. However, many of the tolerance levels were developed based on one or two studies. It does give the basis for comparison of alternatives, and as a baseline. It is not necessarily absolute as an answer, because there are many habitat variables that can differ between the study sites and the Davis project area. Various papers recommend leaving densities at various levels and not manage for one species or another. This comparison of alternatives looks not only at the differences between alternatives, but at the differences between methods of quantifying habitat.

Figure 3.12 Mixed Conifer Habitat Distribution of Snags 10" dbh and Greater, Post-Harvest 2006 and 2046

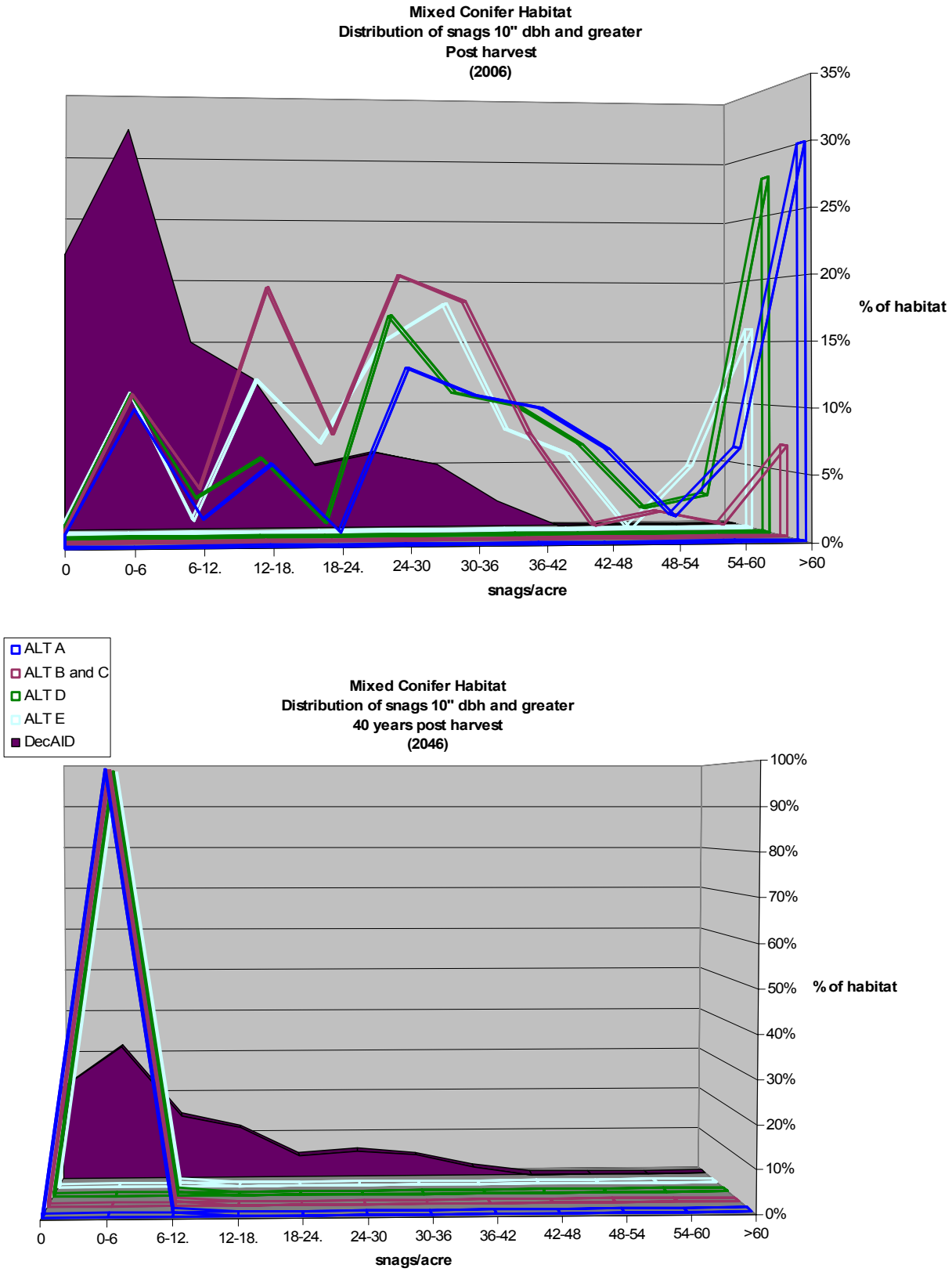
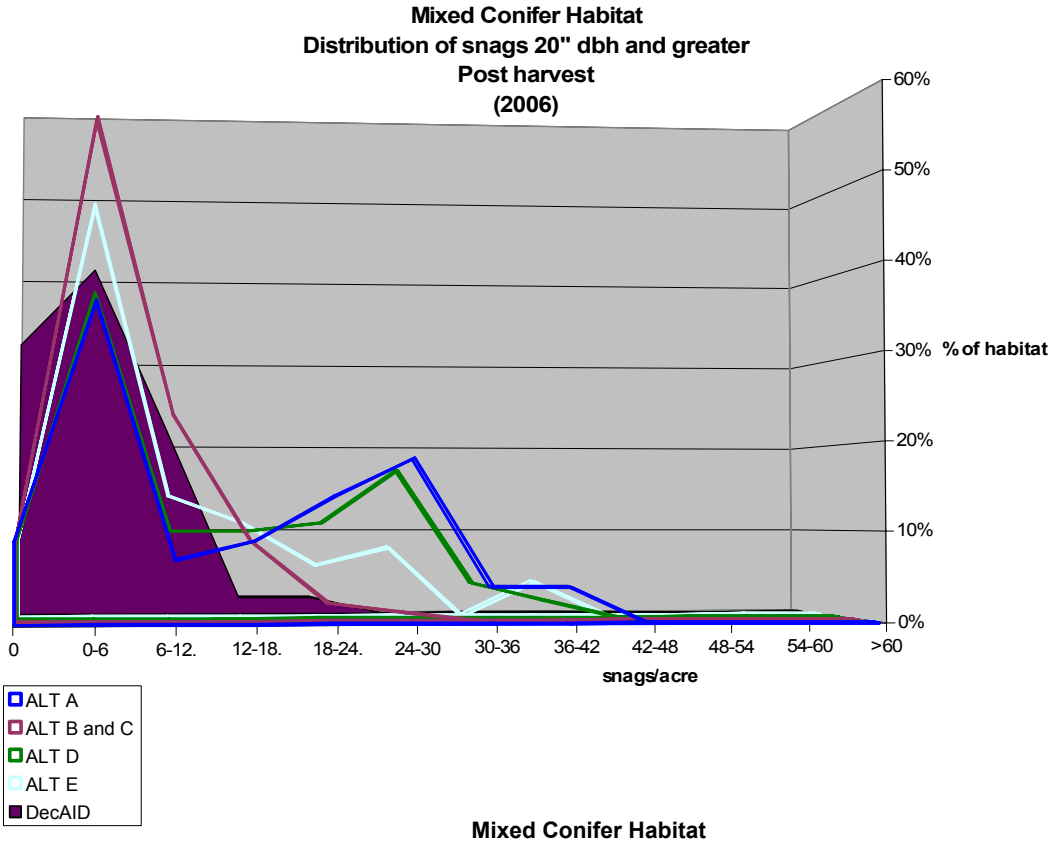
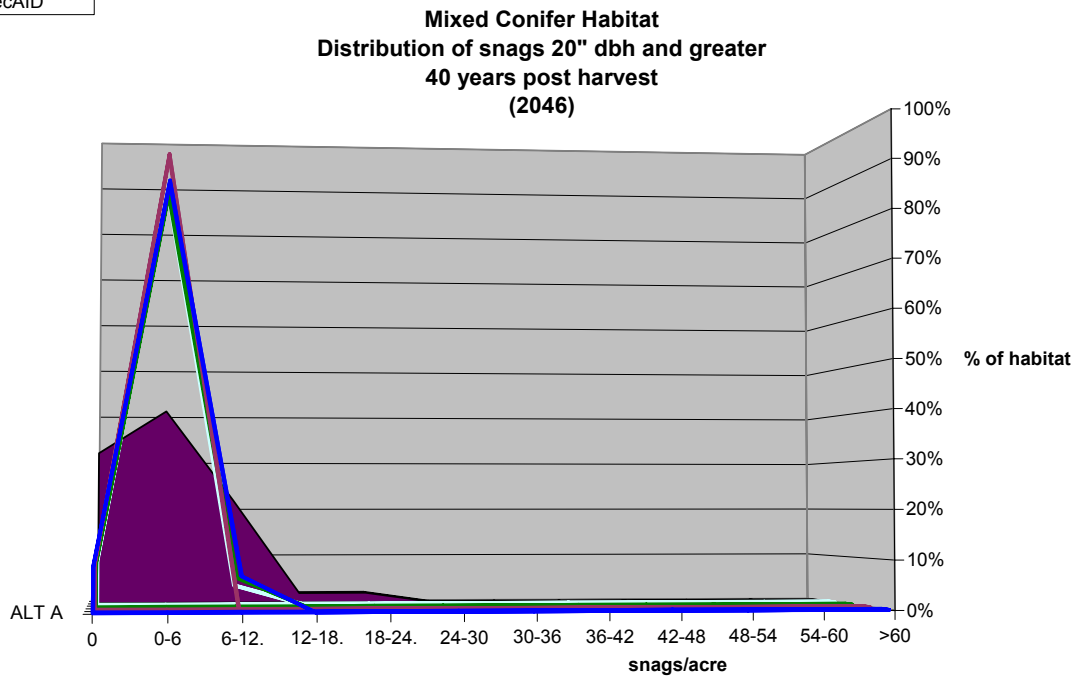


Figure 3.13 Mixed Conifer Habitat Post Harvest Snags 20" dbh and Greater, 2006 and 2046





Haggard and Gaines' (2001) work divided up snag densities in low, medium and high. Two categories are added here to show those that were below the low categories and a maximum category for those acres that exceeded their high category. Categories include: high densities 37-80 snags/ha (14.8-32 snags/ac), moderate densities 15-35 snags/ha (6- 14 snags/ac), low densities 0-12 snags/ha (0-4.8 snags/ac). An "Ideal Category" was also added as Haggard and Gaines found they had the highest diversity at moderate densities at 8.4 snags per acre that were greater than 19 inches dbh. The study only looked at years 4 And 5 post harvest.

Comparing the alternatives with this method (table 3.34), Alternative A provides the greatest density of snags at all levels. However it has few acres in the "Ideal" category because of the high densities. According to these categories, Alternatives B and C actually provide the most "Ideal" habitat. This would provide for the greatest densities of cavity nesting birds.

Table 3.34 Alternative Comparison of Haggard and Gaines' Snag Density Categories

	Below		**Low**		**Moderate**		**High**		**Max**		**"Ideal"**	
Alt.	Acres	% project area	Acres	% project area	Acres	% project area	Acres	% project area	Acres	% project area	Acres	% project area
A	45	0.2%	952	5.0%	2,232	11.8%	4,167	22.0%	11,562	61.0%	3,517	18.6%
B	52	0.3%	953	5.0%	2,348	12.4%	6,763	35.6%	8,856	46.7%	7,891	41.6%
C	52	0.3%	953	5.0%	2,328	12.3%	6,494	34.3%	9,125	48.2%	7,891	41.6
D	52	0.3%	953	5.0%	2,252	11.9%	4,543	24.0%	11,152	58.8%	4,295	22.7
E	52	0.3%	953	5.0%	2,269	12.0%	5,513	29.1%	10,164	53.6%	6,023	31.8

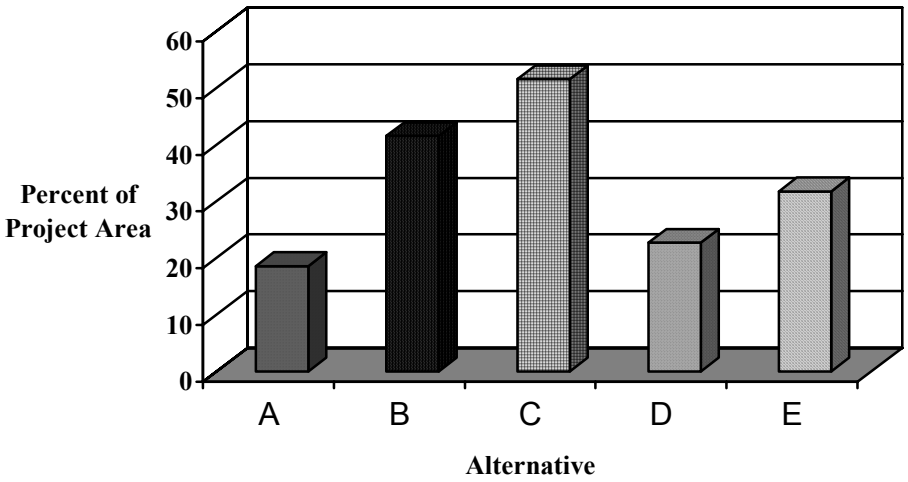


Figure 3.14 Percent of Project Area within the "Ideal" Category by Alternative

Alternatives under the DecAID Tolerances do not necessarily show a different picture. The values are by individual species rather than by group. The group 'cavity nesting birds' changes vary little between alternatives. There is also very little change between alternatives for American marten. Both of these have only one tolerance level in DecAID.

As one would expect looking at the individual species, as the amount of acres that snags are removed from goes up the amount of habitat provided at the higher tolerance levels is reduced. See Post Harvest Tables.

The other side of the story is the amount of habitat and type being developed. The less harvest, the more lodgepole pine and brush there would be across the landscape. The more harvest and planting, the more specific habitat will skip that lodgepole pine/brush stage and move toward early seral fire communities. The acres of this specific habitat development is illustrated by the amount of harvest and reforestation by alternative (table 3.35).

Table 3.35 Amount of Salvage Harvest and Reforestation by Alternative

Action	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Commercial Salvage	0	6,355	6,355	1,045	3,290
Reforestation	0	8,400	8,400	2,030	3,910

Table 3.36 Post-Harvest Comparison of Alternative by Species Using DecAID Tolerance Levels

Species	Alternative	Below 30%		30%		50%		80%	
		Acres	% Project Area	Acres	% Project Area	Acres	% Project Area	Acres	% Project Area
American Marten	A					15160	80.0%		
	B					15124	79.7%		
	C					15124	79.8%		
	D					15160	80.0%		
	E					15124	79.8%		
General Cavity Nesting Birds	A					13289	70.1%		
	B					13221	69.7%		
	C					13200	69.7%		
	D					13289	70.1%		
	E					13252	69.9%		
Hairy Woodpecker	A	1764	9.3%	7487	39.5%	5337	28.2%	4369	23.0%
	B	1830	9.6%	11685	61.6%	4544	24.0%	913	4.8%
	C	1809	9.5%	11478	60.6%	4750	25.1%	913	4.8%
	D	1771	9.3%	8224	43.4%	4980	26.3%	3976	21.0%
	E	1771	9.3%	9877	52.1%	4713	24.9%	2589	13.7%
Mountain Bluebird	A	1194	6.3%	4651	24.5%	12211	64.4%	902	4.8%
	B	1201	6.3%	6673	35.2%	10942	57.7%	156	0.8%
	C	1201	6.3%	6329	33.4%	11164	58.9%	257	1.4%
	D	1201	6.3%	4930	26.0%	12183	64.3%	636	3.4%
	E	1201	6.3%	5442	28.7%	11584	61.1%	723	3.8%
Northern Flicker	A	4944	23.1%	7434	39.2%	6120	32.3%	458	2.4%
	B	4974	26.2%	12825	67.6%	1171	6.2%	0	0.0%
	C	4974	26.2%	12910	68.1%	1066	5.6%	0	0.0%
	D	4937	26.1%	8477	44.7%	5343	28.2%	193	1.0%
	E	4974	26.2%	10320	54.5%	3198	16.9%	458	2.4%
Lewis Woodpecker	A	1460	7.7%	4172	22.0%	5721	30.2%	7597	40.1%
	B	1460	7.7%	5191	27.4%	10014	52.8%	2286	12.1%
	C	1460	7.7%	4877	25.7%	10434	55.1%	2181	11.5%
	D	1460	7.7%	4464	23.6%	6472	34.2%	6554	34.6%
	E	1460	7.7%	4423	23.3%	8393	44.3%	4675	24.7%
Whiteheaded Woodpecker	A	4542	24.0%	4972	26.2%	5440	28.7%	3262	17.2%
	B	4961	26.2%	10044	53.0%	2863	15.1%	348	1.8%
	C	4735	25.0%	10274	54.2%	2859	15.1%	348	1.8%
	D	4786	25.3%	5771	30.5%	4662	24.6%	2997	15.8%
	E	4649	24.5%	7851	41.4%	4023	21.2%	1694	8.9%
Black-back Woodpecker	A	11952	63.1%	2837	15.0%	3916	20.7%	246	1.3%
	B	17319	91.4%	782	4.1%	818	4.3%	31	0.2%
	C	17323	91.4%	779	4.1%	818	4.3%	31	0.2%
	D	12974	68.5%	2142	11.3%	3589	18.9%	246	1.3%
	E	14919	78.7%	1584	8.4%	2303	12.2%	145	0.8%

Forested Vegetation

Key Issue: Passive Recovery in Late Successional Reserve vs. Recovery using Active Management, Including Commercial Salvage

Passive Management in the Late Successional Reserve vs. Recovery Using Active Management, Including Commercial Salvage: Active management in the post-fire landscape is opposed by some people. Some public comments show a desire to "natural" post-fire recovery and passive processes, and alternatives were suggested to restore the area through non-commercial means. Public input on the best approach to recovery demonstrates the divergent points of view on what approach to recovery would best accomplish the purpose and need. The essential indicator for this issue is the recovery of late and old-structured stands over time.

Attributes and Measures: Amount of harvest by method; regeneration by species and method; forest succession and development of LOS.

Introduction

This section provides an overview of the vegetative component within the Davis Fire Recovery Project. Discussions include management direction, historical activities, Potential Natural Vegetation, structural stages of stands, the expected vegetative response following the fire, and the tools used to conduct the analysis of fuels and vegetative response. The alternatives and effects of alternatives to the area affected by the Davis Fire follows the existing condition report.

This discussion is a summary of the specialist report for vegetation management within the Davis Fire Recovery Project area in adequate detail to support the rationale for the decision. For more detailed discussion, the Project Record located at the Crescent Ranger District contains the entire report and is hereby incorporated into this document.

Management Direction and Desired Future Condition

Brief descriptions of the Management Areas and associated direction from the Deschutes Forest Plan and Amendments are included on pages 1-10 to 1-12. Distribution of the Management Areas and Allocations are displayed in figures 1.4 and 1.5. Proposed activities are located primarily in two Northwest Forest Plan Allocations: Late Successional Reserve and Matrix.

Late Successional Reserve

The objective of Late Successional Reserves (LSRs) is to protect and enhance the condition of late-successional/old-growth forest ecosystems, which serve as habitat for dependent or old growth associated species including the northern spotted owl. Some of the Deschutes National Forest LSRs provide habitat for species which rely on late structured stands maintained by frequent, low intensity fire regimes. These "fire climax" late and old growth stands provide habitats for late and old growth related species not usually associated with the "climatic climax" stands in the Province. Because of this mix of "westside" and "eastside" vegetation types and conditions, management efforts should focus on maintaining the dynamic balance of all the vegetative types and conditions, to include both climatic climax and fire climax ecosystems. This will provide opportunities for ecosystem maintenance and restoration for existing and potential natural vegetation (USFS 1995a).

The Desired Condition for the 1996 Davis Late Successional Reserve (in general) was to balance vegetative conditions to allow the LSR to function as intended and be sustainable in the short and long term under conditions characterized as the "East Cascades Fire Regime." In December 2002, the Crescent Ranger District LSRA team identified a problem associated with a high risk lodgepole pine stand adjacent to the western edge of Davis Lake and the plan was amended. Before the fuel loadings could be implemented, the Davis Fire was ignited on June 28th, 2003.

Applicable Standards and Guidelines for risk reduction and salvage within the LSR can be found on pages C-13 through C-16 in the Record of Decision for the Northwest Forest Plan.

Matrix

The matrix lands include all Federal lands within the Northwest Forest Plan not falling in other categories. They include non forested as well as forested areas that may be technically unsuited for timber production. Forests in the matrix function as connectivity between Late-Successional Reserves and provide habitat for a variety of organisms associated with both late-successional and younger forests. The matrix will also add ecological diversity by providing early-successional habitat. The objective is to provide coarse woody debris well distributed across the landscape in a manner which meets the needs of species and provides for ecological functions. Coarse woody debris already on the ground should be retained and protected to the greatest extent possible from disturbance during treatment which might otherwise destroy the integrity of the substrate. Matrix lands were also intended to produce commercial yields of wood and ecological diversity by providing early-successional habitat. In the Matrix, objectives after stand-replacing events include economic benefits of timber production and replanting disturbed areas as a high priority.

Applicable Standards and Guidelines for vegetative treatments in Matrix lands can be found on pages C-40 through C-42 of the Record of Decision for the Northwest Forest Plan.

Historic Activities

The pre-fire conditions within the Davis Fire area could be characterized as overly dense forest containing large trees. Previous to the Davis Lake Fire, the last stand replacement fire (probably at a much lesser extent) in the mixed conifer plant association group occurred approximately 250 years ago (Stone, 2003). With some survival of the older trees and natural regeneration aided by probable favorable climatic conditions, a new forest was established. Scattered throughout were large trees, mostly Douglas-fir, older than 250 years that survived. Prior to the Davis Fire, district personnel noticed multiple fire scars on these trees, indicating multiple fire return intervals prior to fire exclusion that began at the turn of the century.

The 1999 Odell Watershed Analysis describes the area as increasing in productivity due to fire exclusion in stands where a high frequency, low intensity fire regime had been altered (Page 44). Typical of other stands throughout the west, several different management scenarios were implemented, reflecting National Forest policy direction of that period. In the 1960-1970s, individual trees were removed that were deemed at high risk to insect attack and mortality. Also prior to 1994 when the Northwest Forest Plan was implemented, some fragmentation occurred in stands that were converted from “overly mature and decadent to healthy, thrifty stands” (Page 44). During this period there was mortality in large old ponderosa pine caused by overcrowding and competition with other trees, evidenced by the snags that remained on the landscape pre-fire. Artificial regeneration consisted of species that were ponderosa pine, Shasta red fir and western white pine.

More recently, the Crescent Ranger District attempted to address the shift of the species composition and density of the LSR stands by implementing projects such as the Seven Buttes and Seven Buttes Return vegetation management projects. These projects were aimed at reducing the susceptibility of stands to fire and insect mortality in the early seral overstory trees by thinning the understory and introducing prescribed fire in appropriate stands while maintaining a balance of suitable habitat for species dependent on dense forests such as the Northern spotted owl. Stand treatments were designed to remove up to one-third of the basal area within selected overstocked stands and leave large diameter trees with reduced competition from the understory. Some units which had these prescriptions implemented prior to the fire were used for placement of fireline, burn out, and stop the advancement of the Davis Fire.

In the lower elevation of the fire area where it originated near Davis Lake, although limited, salvage of dead lodgepole pine had occurred in the 1980s and 1990s, stands were generally intact. Prior to this event, stand replacement wildfire was documented by the Bend Bulletin newspaper in the 1930s. Since then, as a result of lodgepole pine stands nearing the end of their life cycle, ideal fire weather conditions, and the proximity to heavily-used Davis Lake recreation provided conditions for another stand replacement event.

Existing Conditions

Potential Natural Vegetation

Fire Impacts

Stand composition and structure prior to the Davis Fire are described in the Davis Late Successional Reserve Assessment (Davis LSRA), Odell Watershed Assessment (Odell WA) and the Seven Buttes Environmental Assessment and are incorporated as references. Potential natural vegetation is defined as the plant species that would be expected to be established on a given site in the absence of disturbance. Field mapping of the potential natural vegetation (at the plant association level) was completed using methods designed by Volland (1985).

Pre-fire vegetative condition and the historic development are described in the Davis LSRA and were used to summarize the post fire condition described in table 3.68. Plant associations were then grouped by climax species, site potential, and temperature and moisture similarities into plant association groups (PAGs). Each PAG was historically initiated and developed in relationship to the influence of fire. The PAGs within the Davis Fire Recovery area are: lodgepole pine, ponderosa pine wet, ponderosa pine dry, mixed conifer dry, mountain hemlock, and grass/brush. Discussion for the grass and forbs PAG is not covered as extensively as the other groups because there are no proposed activities within riparian reserves/buffers and discussions are found elsewhere under the headings water quality and soils.

The following table 3.37 shows the distribution of PAGs and fire intensity within the Davis Fire Area.

Table 3.37 Plant Association Group and Fire Intensity (Acres)

Vegetation Type (PAG)	High Intensity[1]	Moderate Intensity[2]	Low Intensity[3]	Unburned
Lodgepole Pine	688	1,518	495	573
Ponderosa Pine Wet	206	574	302	40
Ponderosa Pine Dry	185	446	190	57
Mixed Conifer Dry	8,866	2,900	2,020	741
Mountain Hemlock	4	73	348	51
Grass/Brush	65	37	370	213

All high and most moderate burn intensity areas resulted in 100% mortality (stand replacement). These are 48 and 26 percent of the fire area, respectively.

Historic Condition

Fire suppression has not necessarily had the greatest impact on fuel accumulations on sites and in forest types that historically have had the most frequent fires. After a century of fire exclusion, a forest belonging to the Ponderosa pine PAG may be many fire-return intervals outside its historical range—perhaps 100 years without wildfire, where

[1] High Intensity: Resulted in mortality to the tree and all needles are consumed in the fire

[2] Moderate Intensity: Resulted in mortality to the tree and all the needles on the trees were scorched and are brown

[3] Low: Rates of mortality vary within three years dependent on species, scorch heights, and insect infestations (USFS 2003). There are green needles visible on the tree (Scott et al, 1996; Scott et al, 2003)

the historical pattern was a fire every 5 to 10 years. But the effects of 100 years of fire exclusion on amounts and arrangements of fuels and the potential for an uncharacteristic stand-replacement fire actually may be much greater in a mixed conifer forest belonging to the white fir PAG, which is only three or four intervals outside its normal fire cycle of 10 to 60 years. This is because the white fir site is much more productive than the Ponderosa pine site, resulting in more rapid fuel accumulations and the development of white fir fire ladders between ground and crown fuels. Historic fire-return intervals are therefore not always the best basis for setting fuel treatment priorities and this scenario applies to the Davis Fire PAGs.

The following discussion for the Historic Range of Variability (HRV) was updated using data from the Odell Watershed Assessment (USFS 1999). Historic Condition or reference condition as used here describes vegetative conditions prior to being notably influenced by direct and indirect affects of European settlement. Historic records, fire-scarred stumps, tree ages, and other documented studies were used to gather information to estimate historic conditions.

Use of historic conditions as a basis for comparison assumes dependent vegetative and wildlife populations habitat requirements are provided across the landscape. While such an approach and assumptions may not be perfect, it was chosen to approximate past conditions, to compare historic and present conditions, and to estimate the desired conditions that might reasonably be expected to maintain a sustainable, viable ecosystem. The Following is a brief description of structural stages used for analyzing Historic Range of Variability (HRV) and comparing existing conditions with historic conditions.

Table 3.38 Description of Structural Stages

STRUCTURAL STAGE	DESCRIPTION
Stand Initiation	One canopy stratum (may be broken or continuous), on dominant cohort of seedlings or saplings. Grass, forbs or shrubs may be present with seral trees.
Understory Re-initiation	The overstory canopy is discontinuous. Two or more canopy layers are present. Overstory trees may be poles or of small or medium diameter. Understory trees are seedlings or poles.
Stem Exclusion: Open Canopy	One discontinuous canopy stratum. One cohort of tree stems excluding competition. Trees may be poles of small or medium diameter. Understory shrubs, grasses, or forbs may be present.
Stem Exclusion: Closed Canopy	Canopy layer is closed and continuous. One or more canopy strata may be present. Lower canopy strata, if present, is the same age as the upper stratum. Trees may be poles or small or medium diameter. Understory shrubs, grasses, or forbs may be present.
Multi-stratum without Large Trees	The overstory canopy is discontinuous. Two or major canopy layers are present. Large trees are uncommon in the overstory. Horizontal and vertical stand structure and tree sizes are diverse. The stand may be a mix of seedlings, saplings, poles, or small or medium diameter trees.
Multi-stratum with Large Trees	The overstory is broken or discontinuous. Two or more canopy layers are present. Medium and large sized trees dominate the overstory. Trees of all sizes may be present. Horizontal and vertical stand structure and tree sizes are diverse.
Single Stratum with Large Trees	The single dominant stratum consists of medium sized or large trees. One major cohort of trees may be present. An understory may be absent or consist of sparse or clumpy seedlings or saplings. Grasses, forbs, or shrubs may be present.

Classification of stands within the fire area was accomplished using extensive field observations and recent pre-fire vegetative data, modified by the fire intensity in individual stands. The classifications used here (table 3.39), as well as the process of comparing current conditions with historic conditions were used in the Interior Columbia Basin Ecosystem Management Project (USFS and USDI Bureau of Land Management 1997). Stands which have high mortality (moderate and high intensity) within the fire area are now classified at the stand initiation phase. In the mixed lethal fire and low intensity fire areas it is assumed the stands have lost or will soon lose the majority of the understory component of fire intolerant species. This condition equates to a stand classification of stem exclusion (open canopy) or single stratum (large tree). Either of these stand types have the potential to develop an understory and return to the multi stratum classification (important for species such as the northern spotted owl) in a relatively short timeframe. In the mixed lethal fire areas, the potential for additional area to shift to the stand initiation stage

increases as mortality of the remaining trees takes place during the next decade due to insects and root mortality. This is especially true for lodgepole pine.

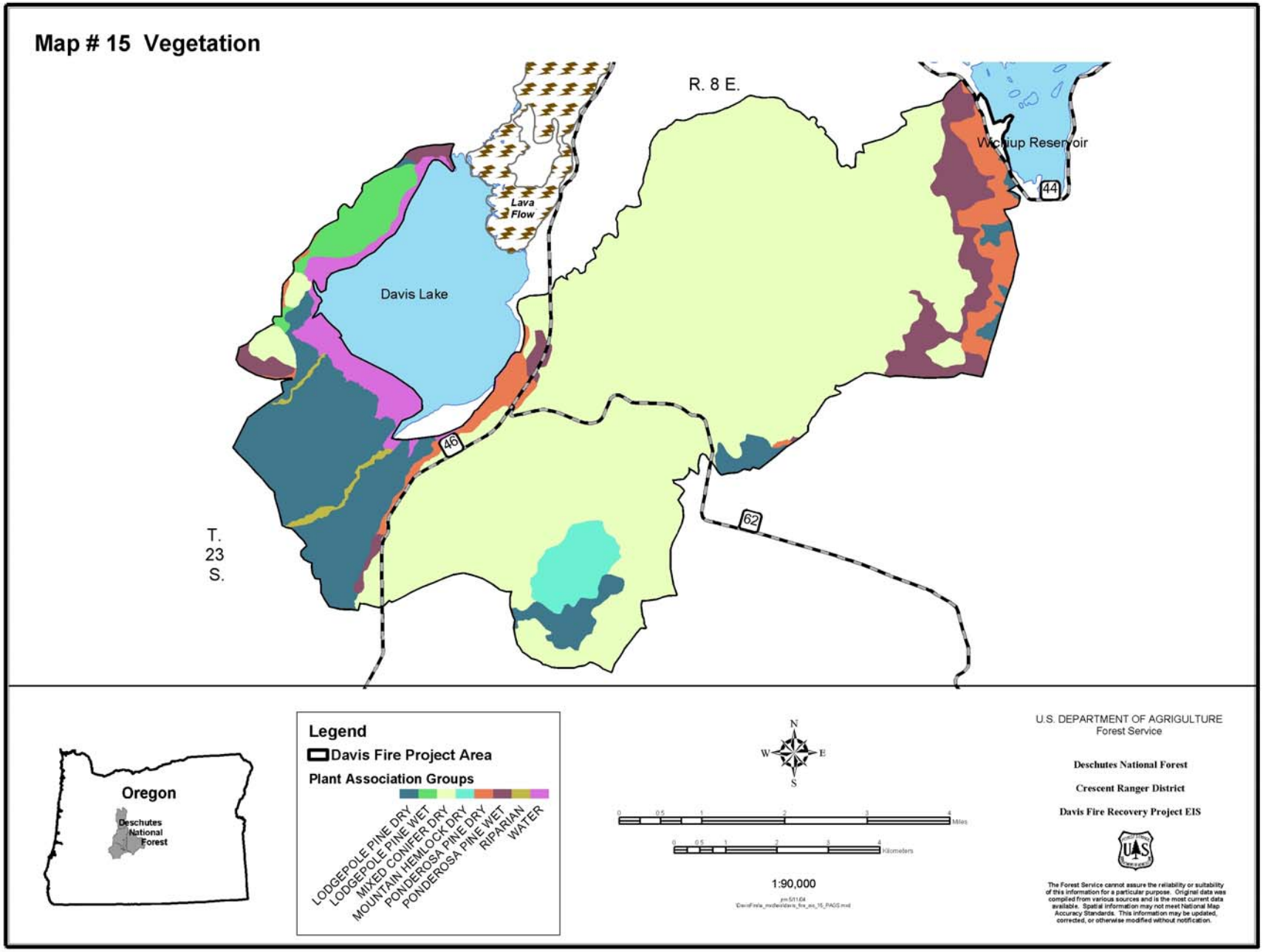
Table 3.39 Post-Fire Seral-Structural Stages by Plant Association Group Compared to District-wide Historic Range of Variability

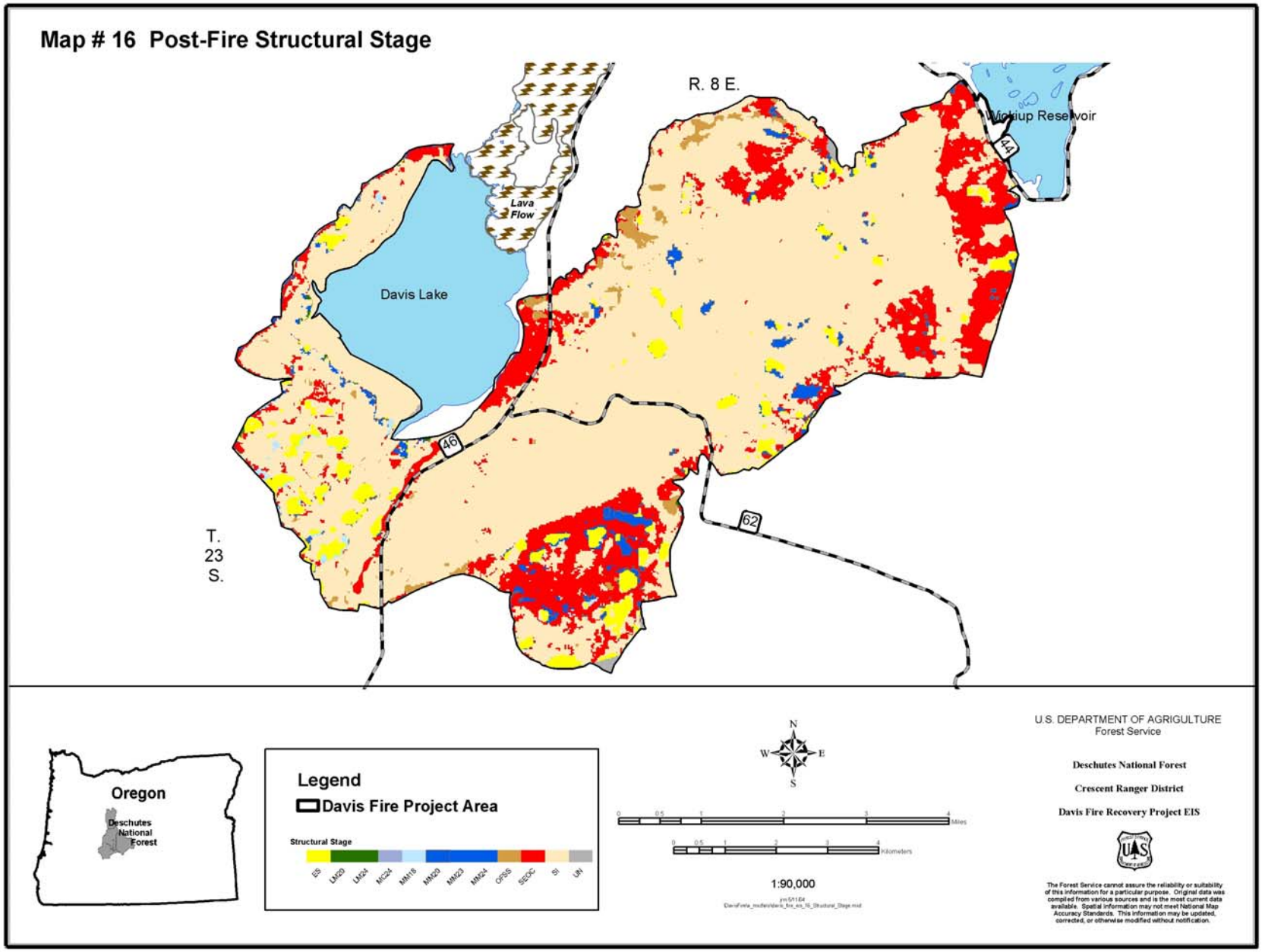
Plant Association Group / Structural Stage	Mountain Hemlock Acres	Mountain Hemlock Percent[4]	Ponderosa Pine Wet Acres	Ponderosa Pine Wet Percent[5]	Ponderosa Pine Dry Area	Ponderosa Pine Dry Percent	Lodgepole Pine Acres	Lodgepole Pine Percent	Mixed Conifer Dry Acres	Mixed Conifer Dry Percent
Stand Initiation	104	22	453	40 (0-20)	264	30 (0-20)	2,774	85 (0-70)	12,446	86 (0-20)
Understory Re-initiation		0	0	0 (5-30)	0	0 (5-30)	0	0 (0-10)	0	0 (15-50)
Stem Exclusion Open Canopy	347	73	653	58 (15-30)	590	67 (15-30)	293	9 (0-20)	1,520	10 (15-50)
Stem Exclusion: Closed Canopy	0	0	0	0 (0-10)	0	0 (0-10)	0	0 (0-50)	0	0 (7-20)
Multi Stratum without Large Trees	25	5	16	1 (15-60)	24	3 (15-60)	170	5 (0-10)	299	2 (10-55)
Multi Stratum with Large Trees	0	0	0	0 (0-20)	0	0 (0-20)	10	0 (0-10)	3	0 (8-30)
Single Stratum with Large Trees	0	0	0	0 (20-50)	0	0 (20-50)	33	1 (0-30)	259	2 (15-60)
Total for Fire Area	476		1,122		878		3,280		14,427	

Although overly dense prior to the fire, the multi stratum stand structure was important for management of the Northern Spotted Owl (Davis LSRA). As a result of the wildfire, all PAGs are now dominated by the stand initiation structural stage and are no longer within the historic range of variability identified for the District. This is true especially in the large diameter groups for most of the PAGs. Before the fire, the area was outside historic range of variability with most of the stands in the multiple strata classifications with large tree components (Davis LSRA). This loss in the multi-strata structural stage is a large change for the spotted owls which historically nested in the area.

[4] No District-wide Historic Range of Variability is available for mountain hemlock.

[5] District-wide Historic Range of Variability is displayed in parenthesis ( ).


Map # 15 Vegetation
R. 8 E.
T. 23 S.
Davis Lake
Lava Flow
Wickiup Reservoir
46
44
62
Oregon
Deschutes National Forest
Legend
Davis Fire Project Area
Plant Association Groups
LODGEPOLE PINE DRY
LODGEPOLE PINE WET
MIXED CONIFER DRY
MOUNTAIN HEMLOCK DRY
PONDEROSA PINE DRY
PONDEROSA PINE WET
RIPARIAN
WATER
N
W
E
S
Miles
Kilometers
1:90,000
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS
The Forest Service cannot assure the reliability or suitability of this information for a particular purpose. Original data was compiled from various sources and is the most current data available. Spatial information may not meet National Map Accuracy Standards. This information may be updated, corrected, or otherwise modified without notification.


Map # 16 Post-Fire Structural Stage
R. 8 E.
Wickiup Reservoir
Lava Flow
Davis Lake
46
44
62
T. 23 S.
Oregon
Deschutes National Forest
Legend
Davis Fire Project Area
Structural Stage
ES
UM20
UM24
MC24
MM18
MM20
MM23
MM24
OPSS
SEOC
SI
UN
N
W
E
S
Miles
Kilometers
1:90,000
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS
The Forest Service cannot assure the reliability or suitability of this information for a particular purpose. Original data was compiled from various sources and is the most current data available. Spatial information may not meet National Map Accuracy Standards. This information may be updated, corrected, or otherwise modified without notification.

The following is a brief description of plant association groups, vegetation response, and the pre-fire conditions found within the Davis Fire Recovery Area. For more specific information refer to the Davis LSRA and Odell Watershed Analysis.

Lodgepole pine

Inside the Davis Fire, 81% of the lodgepole pine stands experienced almost total mortality. Lodgepole pine PAGs are generally located in the lower elevations of the fire near Davis Lake and Wickiup Reservoir. Typical of the prolific nature of this species, the area is characterized as flat with frost pockets where most other species cannot become established. Presently, stands are in a common cyclic condition which occurs on a 60 – 100 year rotation of dying, burning, and regenerating (Franklin 1973; Brown & Smith eds. 2000). It has a low tolerance to fire and widespread mortality caused by insect attack is a common event in its life cycle. Also, if lodgepole pine is present, it is generally the first species to regenerate following a wildfire. In central Oregon, it is generally considered non-serotinous (i.e., heat usually does not trigger the opening of cones) and thus the seed tends to be transitory in the environment. However, during a fire event, the cones remain on the trees and some seed remains in the base of the cones. Seed release and dispersal can be inconsistent in occurrence and viability following a fire, but the Davis Fire is expected to regenerate the lodgepole pine stands at some level from seed which persisted inside the cones, at least in relation to the mixed conifer stands, which have no seed source. The rule of thumb for natural regeneration success is twice the distance of the height of the tree from the edges of the fire were live trees remain and around burned trees with cones.

The remaining 19% of lodgepole pine stands that experienced a low intensity fire are also expected to die because of a low tolerance to fire. The only exception would be stands that were regenerated in the last three decades, are of sapling size, and had almost no ground fuels present when the ground fire front reached the edge of the stand. These stands may have survived, but do not provide a seed source.

Other vegetation expected to recover within this zone in the next decade consists of grasses, forbs, and willows (in wet areas). Spirea, willow, sedges and bunch grasses have already begun to resprout.

Mixed Conifer Dry

The mixed conifer plant association stands make up the majority of the fire area and experienced approximately eighty percent mortality. Typical stands, as described in the watershed analysis and late-successional reserve assessment documents, were dominated by ponderosa pine and Douglas-fir with varying components of sugar pine, Shasta red fir and white fir. Western white pine historically would have been represented in greater numbers, but the exotic disease white pine blister rust has vastly reduced its presence. Ponderosa pine is less prevalent as the elevation increases up Hamner Butte and Davis Mountain. The understory, or trees that developed under the canopies of the larger trees, were allowed to become uncharacteristically large (up to 24” in diameter) due to fire exclusion and consists mainly of lodgepole pine, Douglas-fir, Shasta red fir, and white fir.

Both the watershed analysis and late-successional reserve assessment documents describe these stands as highly-stocked, not sustainable and imminently susceptible to a disturbance event (Maffei et al. 1996). In a condition described as common for western forests (Beschta 1995; Agee 1993; Franklin 1973; Arno 1995), these stands were established in a similar manner as the ponderosa pine types with frequent low intensity fires. Stand density and the mix of species were maintained with low intensity fires until fire suppression was established about the turn of the century. Since that time, a shift to shade tolerant species has occurred, with the understory becoming heavily stocked. Also within the fire perimeter were openings of younger stands that were regenerated in the 1970s and 1980s. Many of these “plantations” experienced mostly 100% mortality due to the intensity of the surrounding fire.

The condition of the stands in the Davis Fire caused a fire intensity and size atypical to historical fire regimes within these plant association types. According to the Deschutes National Forest’s Watershed Evaluation and Analysis for Viable Ecosystems (USFS 1994), stand replacement events would occur at a frequency of 75-100 years and the patch size would be 100-1000 acres, dependent upon the aspect. More typically, the stands would have had small acreages where mortality of the overstory occurred due to insects or fire. Large areas of fire would affect mostly the smaller understory trees and not the early seral overstory. These fires, when overstory mortality occurred, would be in small patch sizes and would be in close proximity to scattered remaining overstory seed trees (Arno 1995). These openings would become regenerated and would develop into another patch of younger stems. Historically, snags would be present in small dense clumps (Agee 2002). This is where there would be high levels of fuels over the short term, however, frequent fire return intervals would maintain these clumps to a level where the intensities and fire residence times were much lower than the intensities experienced in the Davis Fire.

Most conifer seed is located in the top layers of duff (Brown & Smith eds 2000). Regeneration historically would be prolific with ponderosa pine, generally the species dominating the stand. Seedbed preparation from frequent fire in conjunction with increased cone and seed production would allow quick regeneration in the small stand replacement fire areas (Brown & Smith 2000).

Within the Davis Fire, regeneration will be sporadic and concentrated along the perimeter. This is due to lack of remaining seed source. The wildfire occurred relatively early in the season before seed had been allowed to mature and become viable within the cones. A majority of the seed source that was present on the ground was killed as the duff layer was consumed. A small amount of seed may have survived in underground squirrel and rodent caches.

It is important to have a sustainable forest that includes large fire tolerant tree species in order to meet long term objectives for dependent species (USFS 1995). Contrary to what likely historically occurred in these stands dominated by ponderosa pine and Douglas-fir overstory (Arno 1995), because of it's prolific nature, lodgepole pine is expected to become a much greater component of the regenerating forest. Also, adjacent to the wildfire perimeter, a shift in species composition has allowed a much greater seed source from fire intolerant species. These are important as a lesser component in the understory, but have a much greater chance to become established and shift stands away from a forest that provides suitable habitat for those wildlife species that need ponderosa pine and Douglas-fir forest the most.

Vegetative response for herbaceous species will be similar to the ponderosa pine types though more sclerotic brush species will be established. Root sprouting of ceanothus and chinquapin within the fire perimeter occurred before the fall of 2003. Contrary to the seed source for tree species, brush species (including manzanita) are persistent and seed can remain viable for many years after a wildfire event (Schopmeyer 1948). Within the fire area, perennial grasses and forbs were common and have regenerative structures in the soil. Because the fire severity (or heat pulse into the soil) was classified as mostly low, these plants had the ability to survive. Also, seed is light and would likely be transported into the fire area by animals and wind.

Prior to fire suppression and exclusion at the turn of the century, following a wildfire event, the number of trees that first became established in open stands was relatively low. Estimated at 20 trees per acre (Agee 2002), it was mostly fire tolerant species such as ponderosa pine and Douglas-fir as they were the overstory trees that were present to supply the seed source. Following fire exclusion within the Davis Fire area, establishment and growth of fire intolerant species such as white fir and lodgepole pine was exceptional. Prior to the wildfire, there were up to 100 to 200 trees per acre and these fire-intolerant species had grown much larger (greater than 10" diameter at chest height) than would be the norm for a fire-adapted stand. Post fire, standing dead trees are presently far above the historic levels found in ponderosa pine dominated mixed conifer plant associations before fire exclusion. This is mostly true in the areas where the moderate and high fire intensities were lethal. Also within areas that experienced low intensity fire, there will be high levels of mortality in the understory. Agee (2002) states the historical levels of fuels after the dead trees fall down was probably averaging 18 tons per acre. Fuel inventories on the Davis Fire have indicated a potential fuel level averaging 100 tons per acre.

Ponderosa Pine Dry

The ponderosa pine types develop over an extremely long period covering centuries compared to decades for lodgepole pine. Some of the age estimates of larger diameter ponderosa pine were 700 years old. The ponderosa stands within the fire perimeter were either dominated by large 250 + year old ponderosa pine and Douglas-fir, or were early successional sapling and pole stands regenerated after timber harvest in the last 30 years. The stands dominated by larger old ponderosa pine and Douglas-fir also had a high population of understory trees except where thinning and removal of the understory had occurred. Ponderosa pine dominated the understory in the driest of the pine associations. Douglas-fir, lodgepole pine and white fir increased in areas ecotonal to the mixed conifer plant associations. This condition, as mentioned in the Davis LSRA, Odell WA, and the Seven Buttes EA, was not sustainable and mortality of the overstory was imminent due to insects or fire (Agee 1996). The Davis fire killed many of the stands with heavy understories. The fire was contained utilizing stands that had thinning or removal of the understory. Some of the largest ponderosa pine survived on the perimeter of the fire with varying amounts of the tree live crowns remaining. These are highly susceptible to mortality in the next decade due to insect attacks by wood borers and western pine beetle (Mitchel & Martin 1980).

The early successional stands of saplings and poles burned at a much lower intensity due to the lack of fuels continuity and loading. However these stands have very high mortality from the fire because of the small size of the openings and intensity of the surrounding fire and hot gases which blew through them. The condition prior to the Davis fire was outside the historic range of variability (Agee 1993; Franklin 1973; USFS 1995; USFS 1999). The large continuous

acreage of multi-structure ponderosa pine with heavy stocking in the understory was historically uncommon on the landscape because ponderosa pine stands tended to have small areas of mortality following any light fire, so small areas of regeneration or openings with mostly stands of larger diameter stems and little brush or fuels in the understory dominated the landscape (Arno 1995). Common low mortality fires kept the fire-intolerant species and high stocking of ponderosa pine from becoming established.

As documented in many places (Beschta 1995; Agee 1993; Franklin 1973; Arno 1995) these stands had developed outside the historic range of variability, were burnt outside the historic range of fires (uncharacteristically severe), and now have a pulse of snags and fuels outside the historic range of variability (Agee 2002a; Brown 2003). Historically in ponderosa pine types, few stand replacing fires occurred, though pockets of mortality would occur due to fire or insects. When stand replacement fires did occur the stand would be replaced but scattered remnant trees would remain through the stand as seed sources allowing the reestablishment of ponderosa pine on the sites (Arno 1995). This was seen in the Davis Fire area with scattered very old ponderosa pine trees (700 yrs estimated, personal observation) which initiated the dominant overstory stand of 200 – 400 year old overstory ponderosa pine and Douglas-fir. The snag and down fuels present in historic stands of this population were low, typically less than 25 tons per acre of fuels and fewer than 8 snags per acre (Agee 2002a). Historically the down fuels were light with small areas of concentrations that had short residence time due to frequent low intensity fires (Agee 1993).

The ponderosa associations within the Davis Fire area are in a less common cyclic condition than the lodgepole pine areas. The area of the fire identified as moderate or high fire intensity is much larger than the low intensity fire area. Moderate and High intensity fire areas have complete or nearly complete mortality of the trees. The low intensity fire area has high mortality to the understory trees. The level of dead biomass in the mixed lethal and lethal areas of the fire are beyond what would develop with more frequent lower intensity fires (Agee 2002a; Brown 2000; Arno 1995). The ponderosa pine and dry mixed conifer stands would typically not have large stand replacement events (lethal fire) nor stand replacement events where no surviving seed source of early seral species survived within stands (Arno 1995). Following the Davis fire stands had high mortality in the understory *and* overstory and thus high levels of standing fuels ranging from 15 tons per acre to 148 tons per acre, averaging 100 tons per acre. Prior to the fire, stocking of the understory of stands had high tree densities ranging from 300 trees per acre under 12” dbh to 2,500 trees per acre. These highly-stocked understory trees had high rates of mortality because they were shade tolerant, fire susceptible species. The fuel loading from just these understory trees averages above 20 tons per acre of fuels. The total fuels levels which are considered sustainable and common in these stand types are less than 24 to 30 tons per acre (USFS 1995; Brown 2003; USFS 1999; Agee 2002a).

Within the ponderosa pine plant associations there were many areas of mixed intensity fire where the overstory trees of ponderosa pine have highly variable rates of scorch of the crowns and boles. There are many papers on evaluating fire damage of ponderosa pine and predicting the probability of mortality (Flanagan 2001; Weatherby et al, 2001; Wagener 1961). Predicting the overstory survival is based on many variables such as tree stress, moisture availability, bole scorch, cambium scorch, crown scorch and insect dynamics. The overstory in the mixed lethal areas will have mortality ranging from few to many of the ponderosa pine. The ponderosa pine overstory had heavy competition and slow growth due to moisture stress and limited nutrient availability. This level of stress leaves the overstory trees with fire damage at high risk to mortality from insect attacks from the present to a couple decades from now (Arno 1995). Within the mixed lethal fire area most trees in the understory will die since the fire intensity was enough to consume the crowns and cause heavy scorching of boles and the understory trees were of less fire resistant species (Weatherby 2001).

Within the ponderosa pine plant associations the Davis Fire also has areas of high or total mortality with no green needles left on trees. These areas of stand replacing fire are dissimilar to fires in historic ponderosa pine forests. Historically ponderosa pine stand replacement fires were small in stand size and generally had a lower resulting mortality. Typically some trees of the larger sizes would have been left through the stands (Arno 1995). The Davis fire has thousands of continuous acres with no live trees left to disseminate seed. The perimeter trees are also not of the species mix which would historically be present, which would have been near 75% ponderosa pine and 25% Douglas-fir (Brown & Smith 2000; Arno 1995).

Ponderosa pine, as with most coniferous tree species, has a transient seed in the ecosystem. Transient seeds are typically found in the upper levels of duff and are not viable for multiple years (Brown & Smith 2000). Any seed still viable in the duff from the previous year would have been consumed in the burning of the duff, which occurred in all fire intensity levels in the Davis fire. Seed bed preparation and current seed is needed for regeneration of ponderosa pine. Seed dispersal is reduced within 400’ of trees to less than 8% of the seed dispersed (Silvics of North American Trees Handbook Vol. 1). Natural seeding in the fire area will be concentrated around the few live trees within the fire area and adjacent to the edge of the fire. Effective regeneration of ponderosa pine will depend on seed falling where there is little competition or duff accumulation. The lack of periodicity of ponderosa pine cone production makes it

difficult to estimate when the next seed crop may occur (Silvics of North American Trees Handbook Vol. 1). The quick establishment and competition of brush and grasses will limit the early establishment of conifer forest (Volland 1985). Observations of small regenerated stands in the area indicate that less than 50 trees per acre may become established naturally in the next five decades.

With the lack of seed source over large areas of the Davis Fire it is highly unlikely that conifer forest will become established on the ponderosa pine plant association types of the Davis fire. Within these plant associations, lodgepole pine is the primary pioneer species. Revegetation in these plant associations includes sprouting of sclerophyle species of ceanothus and chinquapin from surviving root clumps. Also, germination from persistent seeds will occupy the stand early with manzanita, forbs, and grasses which had persistent seed in the soil, in squirrel caches, or have regenerative structures in the soil (Brown & Smith 2000). Natural regeneration in the fire area is slow and uncertain while the only trees regenerating in the area may be scattered ponderosa pine and lodgepole pine adjacent to seed sources. Conifer forest in the ponderosa pine associations is dependent on seeding or planting before the establishment of brush scrub and grass competition (Volland 1985).

Ponderosa Pine Wet

The ponderosa pine wet is very similar in character and condition to the ponderosa pine dry except that it is on more productive sites. This is usually located between the ponderosa pine dry and mixed conifer plant associations. These stands dominated by ponderosa pine have similar characteristics as ponderosa pine dry but may have some Douglas-fir, white fir and lodgepole pine established in the understory following fire-free intervals. With higher productivity and faster growth than the dry ponderosa pine large trees would be more common and brush response to disturbance would be higher. A difference in fire return intervals would be difficult to identify from ponderosa pine dry or mixed conifer dry plant associations due to the variability of the periodicity of fire events. The ponder pine wet plant associations being ecotonal to contain characteristics of ponder pine and mixed conifer dry types depending on the continuum of the ecotone.

Mountain Hemlock

Mountain Hemlock associations occur on the top of the buttes where soils are coarser and temperatures cooler. These stands were mostly established less than 200-350 years ago following stand replacement fire. These stands were dominated by mountain hemlock with lodgepole pine on the more recently disturbed areas. When open following disturbance, stands are dominated by manzanita, perennial forbs, and grasses (Volland 1985). Regeneration following disturbance takes time and includes western white pine, Shasta red fir, mountain hemlock, and lodgepole pine. These stands have followed the common cycle of long fire interval regimes with stand replacement events.

The Davis fire was not a crown fire in most of this zone; however, the species present typically have high mortality from lethal ground fire. The most fire resistant species in this plant association are Douglas-fir and Shasta red fir. There is little western white pine present in this area due to mortality because of infection by white pine blister rust. Bark beetles and other agents cause high mortality in these plant associations following surface fires even where little impact on the tree crowns is seen (Weatherby & others 2001).

The mountain hemlock plant associations are presently within their historical range of variability since most fires in this plant association are stand replacement events which produce a large pulse of fuels following a fire; brushfields, western white pine, and lodgepole pine are then established; decades later, shade tolerant species of Shasta red fir and white fir are established in the understory of the brush. The habitat is wetter and cooler than lower elevations and fuels do not dry as much as the mixed conifer plant associations allowing the decay process to reduce the fuels with only periodic hazard of fire during drought conditions (Brown & Smith eds. 2000). The conditions for another stand replacement fire may not occur for two or three centuries with or without active management.

Grass/Forb

Grass Forb plant associations are associated with the flooding patterns of Davis Lake. These associations are dominated by perennial and annual grasses and forbs. These plants vary depending on the duration and frequency of inundation. Perennial plants tend to have root structures which survive fire and sprout following light surface burns. The annuals have light seed which allows quick restocking of an area where site preparation from fires has occurred.

Within the Davis Fire area grass and forb plant associations were green from new growth by September 2003 following the fire. These plants had the top structures burnt but the root structures allowed resprouting of the plants.

Grass and forb communities respond to fire with regrowth though frequent fires favor perennial plants since seed may be destroyed following multiple burns if plants do not have the ability to increase populations.

Data and Analysis of Stand Treatments

Vegetative analysis and estimates of stand conditions prior to and following the fire were done using stand exam data from 1993, 1995, and 1997. These were entered into the Forest Vegetation Simulator (FVS) provided by the Forest Service. The documentation, description, instructions, and software for this program are available on the internet at www.fs.fed.us/fmsc/fvs. The Forest Vegetation Simulator (FVS), at its most basic level is a family of forest growth simulation models. Since its initial development in 1973, it has become a system of tightly linked analytical tools. These tools are based upon a growing body of scientific knowledge gleaned from decades of natural resources research and are based on the Prognosis growth and yield model. Fire and Fuels Extension (FFE) to FVS simulates fuel dynamics and potential fire behavior over time and can be used to simulate and predict snag fall down rates, fuel loadings, and parameters affecting fire behavior and fuels accumulation and decay.

This model was used to compare alternative actions in the Davis Fire area including salvaging timber, treating fuels, reforestation by planting, and stand development over time. The model is based on studies measuring stand characteristics throughout the northwest and has specific adaptations for the central Oregon area snag fall down rates and decomposition that are based on Ponderosa pine data collected on the eastern side of the Cascades (Marcot, unpublished data). The decay and fall down rates of snags and fuels within the model vary depending on species, size class and decay status of trees. Snags as they are simulated breaking and falling are added to the surface fuels where further decay modeling happens. This compares better than most other models which are based on west Cascade Douglas-fir snag information (Mellen & Agner 2002).

For snag retention and fall down rates the program models are based on data for different species and size classes. One variable not modeled but which affects fall down rates is micro-topographic position of the snag location (Everett 1999). This is an important factor which affects the lag time between the last snags standing and the earliest recruitment of snags from the next stand. Out year predictions are not predictions for individual snags but for a stand and its overall impacts. The fall down rates and subsequent fuel loadings are important to model to compare effects of removing fuels and not removing fuels in future stand management. Estimates of snag levels expected within the mixed lethal fire areas was done by selecting archetypical stands and modeling varying levels of fire conditions achieving target levels of mortality. These model runs were used because the FVS model will simulate dead trees in a pattern similar to those found in wildfires. The subsequent snag condition and longevity was modeled into the future. These stands did not have the regeneration modeled since it will be highly variable and dependent on the species and number of trees remaining and the amount of crown canopy closure remaining. Through the majority of the mixed mortality areas of the fire it is expected that the natural regeneration of conifer trees will be high.

The FVS program models growth and stand characteristics such as stand height, crown closure and average diameter. This assists comparing alternatives and their effects in future stand development. Using the model, levels of stocking, habitat conditions, and possible management possibilities are developed. The FVS model uses stand density index (SDI) to estimate mortality rates in stands. The growth model in FVS depends on plant association groups to project growth and stocking limitations and has the ability to increase or decrease stand growth if growth data are included.

The stand exam data available for the Davis Fire restoration were extensive and covered most of the proposed action units. There were some units for which no data were available. These included stands which had been shelterwood cut or seed tree cut in the 70s or 80s and areas treated in the most current timber sales from the Seven Buttes EA. These areas were sampled following the fire to inventory the number of trees left following the earlier regeneration cuts and the number of trees still alive. The areas treated by the sales from the Seven Buttes EA, (portions of the Davis Top and Double timber sales) that were within proposed Davis Fire treatment units, were identified and a sample of these was taken and similar stands were used for each unit.

The stand exam data entered into FVS for the Davis Fire area did not include periodic growth data. Therefore projections are made from average plant association productivity. The program probably underestimates the growth potential for the Davis Fire area since the area is located on the more productive parts of the Crescent Ranger District. Fifty year old plantations in adjacent area of Davis Lake in similar plant associations have a range of 12”-17” diameter at breast height (dbh), for the same time period the FVS program predicts an average diameter of 9” dbh though this

includes simulated natural regeneration following the fire which causes averages to be lower than just modeling the planted trees.

The estimates made using FVS for the Davis fire area assumed natural regeneration of lodgepole pine to occur through most of the stands at a rate of 10 trees per acre per cycle (10 years). This rate is probably high since complete consumption of the duff layer and crowns in high intensity areas and crown mortality in moderate intensity areas eliminated any possible seed sources for 2003. Simulation of trees left and fuels treatments used the salvage keyword in FVS. This does not allow the leaving of trees per acre but a percentage of the trees. After identifying the number of snags to be left for each Management Strategy Area (see table 3.41), numerous runs were made to estimate the percentage which came close to the leave trees desired. This for most plant associations and MSAs was found to be salvaging 90% of the trees 12”–20” in skyline and ground based logging systems; 90% of the trees 14”-20” in helicopter units; 80% of the trees 20”-36”dbh were also removed in all units. This level of salvage modeling left an average number of trees which was desired for snag retention (Davis Fire Wildlife Report, Kittrell). This does not include the 15% of units which will receive no treatment. For the tree growth simulation and snag simulation to 100 years following the fire no intermediate treatments were simulated. Artificial and natural regeneration scenarios were simulated though no intermediate treatments or fires were simulated in the intervening years. This then allows the comparison of snag recruitment and stand condition in the future to be compared without the variables becoming exponential. However, with intermediate treatments including thinning, average stand diameters and largest tree diameters would be larger.

Management Strategy Areas

The Davis LSR is divided into Management Strategy Areas (MSAs), which were selected for the management of wildlife species found within the Davis LSR. Management objectives for these species were developed in the Davis LSR Assessment (LSRA). The management objectives developed depending upon the wildlife species needs and the plant association ability to provide through time the conditions for the wildlife species selected. Following the fire the wildlife snag needs and the ability to carry these characteristics into the future were developed to find the desired levels of snags to be left and fuels levels which will allow the future reintroduction of fire into the area (Davis Wildlife Report, Kittrell).

The table on the following page displays the MSA groupings, treatment acres by alternative, and a short description of the prescriptions to be implemented in those treatments.

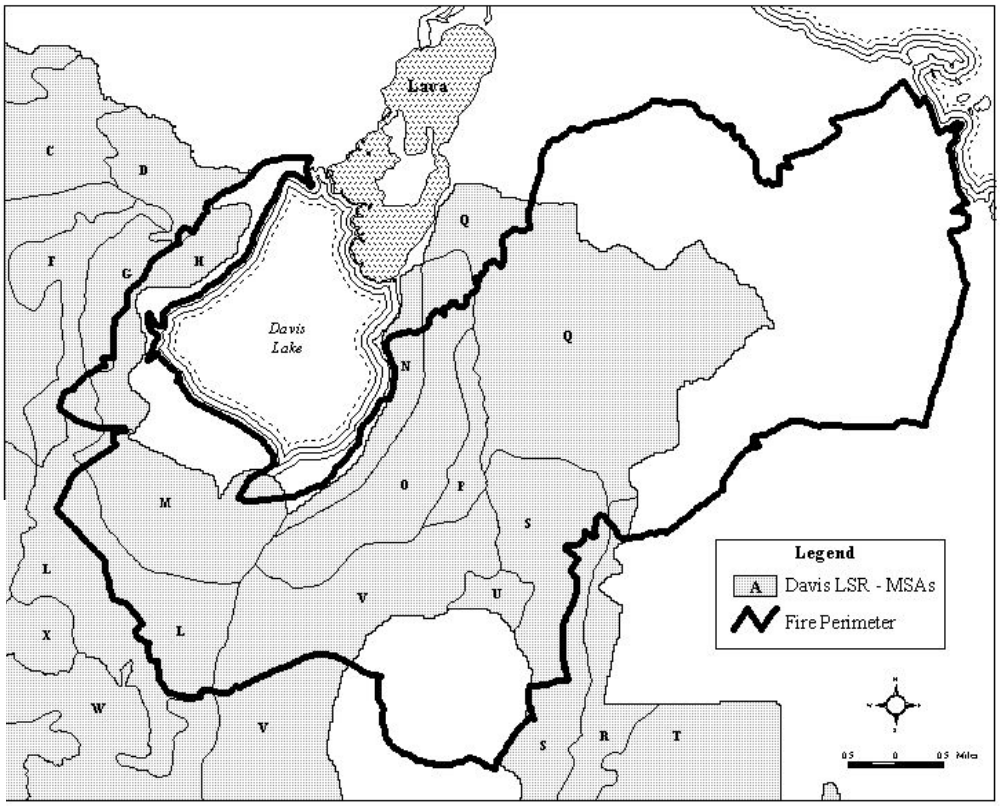


Figure 3.15 Management Strategy Areas of the Davis Late Successional Reserve, Davis Fire Recovery Project Area

Table 3.40 Prescriptions by Management Strategy Areas

Classification	Alternative Acres				Logging System	Wildlife Prescription	Silviculture Prescription	Fuels Prescription
	B	C	D	E				
MSAs: D, F, N, O Eagle Management area Salvage	801	801	0		Ground	5 snags / acre > 20" dbh; target 30% Crown Closure (dispersal habitat)	Salvage Leave > 36" dbh + clumps to make 5 snags / acre Target stand @ 50 yrs PP 150-175 tpa DF 25 tpa	Grapple pile fuels < 12" from main skid trails (60% est.) Burn piles and concentrations Target fuels at 50 years < 15 tons per acre (inc < 5 tons < 6")
MSAs: N, O Eagle Management area Fuels	384	384		384	MEC	Meet owl Nesting Roosting Foraging requirements in units 333 & 334		Mech Remove/ Pile all dead stems < 12" dbh. Remove/Pile green < 9" dbh Burn piles
MSAs: G, H, N Eagle Management area Salvage	289	289		289	Helicopter	5 snags / acre > 20" dbh; Buffer around Eagle nesting and Roosting sites[unit 105] Target 30% Crown Closure (dispersal habitat)	Salvage Leave > 36" dbh + clumps to make 5 snags / acre Leave tops attached Target stand @ 50 yrs PP 175-200 tpa	Logging Leave tops attached Fell all stems < 9" (Buffer around Eagle nesting and Roosting sites[unit 105]) Hand pile Burn piles and concentrations Target fuels at 50 years < 15 tons per acre (inc < 5 tons < 6")
MSAs: H, L, M, R, U Key Elk, recreation area Fuels	45	45	45	45	Ground	10 largest snags/ acre (more towards edges).	Remove all but 10 tpa Monitor for regeneration 2yrs planting LP 190 – 350 tpa (heavier on edges)	Grapple pile and hand pile adjacent to recreation areas Burn piles Target fuels , 15 tons / acre
MSA: M Key elk	175	175	175	175	N/A	Leave it all Target stand 40 % in cover distributed through	Plan Natural Regen Monitor for regeneration 2 yr Plant LP 190 – 350 tpa (heavier on outer chain)in and around prior plantations to meet 40% cover.3rd yr. Target stand Hiding cover in 2-3 decades.	

Classification	Alternative Acres				Logging System	Wildlife Prescription	Silviculture Prescription	Fuels Prescription
	B	C	D	E				
MSA: P Owl Eagle Transition Salvage	236	236	0	0	Ground	8 snags / acre > 20" dbh; Buffer around Eagle nesting and Roosting sites Target 30% Crown Closure (dispersal habitat)and large diameter trees.	Salvage Leave > 36" dbh + clumps to make 8 snags / acre Leave tops attached Target stand @ 50 yrs PP 175-200 tpa	Grapple pile fuels < 12" from main skid trails (60% est.) Burn piles and concentrations Target fuels at 50 years < 15 tons per acre (inc < 5 tons < 6")
MSA: Q, S, V Owl Habitat	1315	2015	0	2215	Helicopter	12 snags / acre > 14" dbh; target 30% Crown Closure (dispersal habitat)	Salvage Leave > 36" dbh + clumps to make 8 snags / acre > 14" Target stand PP 100-125 tpa DF 25 tpa and other 50 tpa (SP, SRF,WP)	Logging Fell all stems < 9" Burn concentrations Target fuels at 50 years < 25 tons per acre (inc < 5 tons < 6")
MSA: Q, S, V Owl Habitat	595	161	0	0	Skyline	12 snags / acre > 12" dbh; target 30% Crown Closure (dispersal habitat)	Salvage Leave > 36" dbh + clumps to make 12 snags / acre Target stand PP 100-125 tpa DF 25 tpa and other 50 tpa (SP, SRF,WP)	Logging Leave tops attached Fell all stems < 9" Burn concentrations Target fuels at 50 years < 25 tons per acre (inc < 5 tons < 6")
MSA: Q, S, V	1777	1512	0	0	Ground	12 snags / acre > 12" dbh; target 30% Crown Closure (dispersal habitat)	Salvage Leave > 36" dbh + clumps to make 12 snags / acre Target stand PP 100-125 tpa DF 25 tpa and other 50 tpa (SP, SRF,WP)	Grapple pile fuels < 12" from main skid trails (60% est.) Burn piles and concentrations Target fuels at 50 years < 25 tons per acre (inc < 5 tons < 6")
Matrix	852	461	729	0	Ground	2-3 snags / acre > 20" dbh; target 30% Crown Closure (dispersal habitat)	Salvage Leave > 36" dbh + clumps to make 2-3 snags / acre Target stand PP 100-125 tpa DF 25 tpa and other 50 tpa (SP, SRF,WP)	Grapple pile fuels < 12" from main skid trails (60% est.) Burn piles and concentrations Target fuels at 50 years < 15 tons per acre (inc < 5 tons < 6")
Matrix	176	0	194		Skyline	3 snags / acre > 20" dbh; target 30% Crown Closure (dispersal habitat)	Salvage Leave > 36" dbh + clumps to make 3 snags / acre Target stand PP 100-125 tpa DF 25 tpa and other 50 tpa (SP, SRF,WP)	Logging Leave tops attached Fell all stems < 9" Burn concentrations Target surface fuels at 50 years < 25 tons per acre (inc < 5 tons < 6")

Classification	Alternative Acres				Logging System	Wildlife Prescription	Silviculture Prescription	Fuels Prescription
	B	C	D	E				
Matrix	0	567	0	567	Helicopter	3 snags / acre > 20" dbh; target 30% Crown Closure (dispersal habitat)	Salvage Leave > 36" dbh + clumps to make 3 snags / acre Target stand PP 100-125 tpa DF 25 tpa and other 50 tpa (SP, SRF,WP)	Logging Leave tops attached Fell all stems < 9" Burn concentrations Target surface fuels at 50 years < 25 tons per acre (inc < 5 tons < 6")
Matrix Fuels	882	882	882	882		Keep overstory In NRF leave green over 6"dbh for owl Space trees less than 6" dbh		Mech Remove/ Pile all dead stems < 12" dbh.(in NRF [unit 390] leave green over 6"dbh) Remove/Pile green < 9" dbh (where needed leave socking on 15' spacing) Burn piles Target surface fuels@ 50 yrs < 15 tons/acre
Eastside Fuels	104	104	104	104		Keep overstory Buffer around Eagle nesting and Roosting sites		Mech Remove/ Pile all dead stems < 12" dbh. (No mechanical in riparian buffers[unit 415]) Remove/Pile green < 9" dbh (where needed leave socking on 15' spacing) Hand pile along 44 road Burn piles Target surface fuels @ 50 yrs < 15 tons/ acre,
Eastside	121	121	121		Ground	8 snags / acre > 20" dbh; target stand 30% Crown Closure (dispersal habitat)	Salvage Leave > 36" dbh + clumps to make 8 snags / acre Target stand PP 175-200 tpa	Grapple pile fuels < 12" from main skid trails (60% est.) Burn piles and concentrations Target fuels at 50 years < 15 tons per acre (inc < 5 tons < 6")
All Areas Reforestation Previous Plantations	2000	2000	940	575	N/A	Leave all Snags present Target Stand 30% crown cover . Mixed species include DF, SRF,.WWP& SP	Target stand 175-200 tpa; PP with DF SP, SRF,WP	N/A

Notes on table 3.40:
PP- ponderosa pine, DF- Douglas-fir, SRF- Shasta red fir, SP- sugar pine, WP- western white pine, LP- lodgepole pine
Planting will use seed conforming to local breeding and elevation zones for PP DF SRF and SP
Rust resistant stock will be used for WP
2-0 or 1-1 DF &- PP plug SRF, SP & WP 2-0 or plug LP
Seasonal Restrictions will occur for Eagle areas around Davis Lake and Wickiup reservoir.
Fuels grapple piling from main skid trails expected treated fuels @ 60% all sub-merchantable.
Felling and burning < 10" dbh and -80% <12" dbh concentrations in skyline and helicopter units.
No salvage of present down material will occur. Stems > 36" felled for safety or corridors will have butt log left.
Within Units, 15% will be left untreated; minimum of 2 acres; maximum 20 acres (includes slopes > 25%, riparian buffers and eagle roost & nest buffers).
Within eagle areas seasonal closure, aerial within ½ mi ground w/in ¼ mi of nest sites Jan. 1 – Aug. 31 and roost sites Nov. 1-March 31.

Environmental Consequences

Alternative A

This alternative would have no active management of the resources except for future fire suppression and roadside hazard tree removal.

Direct and Indirect Effects

This alternative would have the slowest recovery of dispersal habitat for wildlife. Analysis shows average crown cover at 40 years to be estimated below 10% with less than 22% estimated at 100 years throughout the high mortality areas of the fire. Dispersal habitat for spotted owls is considered above 30% crown cover, so these areas wouldn't provide dispersal cover for somewhere more than 100 years. Therefore, this alternative isolates the remaining suitable owl habitat in the project area the longest of all alternatives.

This alternative would have the longest delay in developing a mixed species healthy stand to provide for future forest needs including large diameter trees for wildlife habitat and large snag recruitment. Stand modeling and analysis for this alternative at 40 years shows a stand of predominantly lodgepole pine with some Douglas-fir at an average of 5 inches diameter breast height (dbh). Stocking of these species will be less than 70 trees per acre. Modeling 100 years out following the fire estimates an average stand diameter of 10 inches dbh and crown cover of 20%. This does not provide sufficient large diameter snags or dispersal habitat for spotted owls and associated wildlife species. This alternative would not develop stands dominated by fire adapted species. The species anticipated for initial natural regeneration throughout the fire area in all plant associations would be dominated by lodgepole pine. Douglas-fir and lodgepole pine, perhaps with some very isolated ponderosa pine, would become established in much of the mixed severity fire areas which have openings. Douglas-fir is considered resistant to fire in its second century (Flanagan 2001). The stands which develop with no action would be susceptible to high mortality when the area reburns during the period from 10 to 60+ years (Brown et al 2003).

This alternative would not reduce fuels loadings to levels that allow future introduction of prescribed fire and fire suppression. Fuels that accumulate from snag fall down have three ways of being reduced; they can decay, be removed, or burned. Analysis of fuel loadings due to snag fall down and slow decay of the dead trees currently on the site will accumulate in the stands with high mortality to levels averaging 58 tons per acre in forty years. For prescribed fire to be reintroduced, fuel levels below 15 tons per acre are considered appropriate to minimize killing too many of the residual trees. Fuel levels above 25 tons per acre are considered above the optimum level of coarse woody debris and at a high resistance to control (Brown et al 2003).

The direct effects from the no action alternative, Alternative A, would be to have high levels of standing snags, stocking of high mortality areas of the Davis fire with brush and grasses. Little regeneration of conifer species would occur in these areas. Increased insect populations associated with dead wood would result due to leaving just dead trees. For more information on the insects, refer to the discussion on the insect dynamics, below.

Fuel loading, as noted above, would be such that establishing stands would be imminently susceptible to subsequent fire processes. Conifer species desired to meet long term objectives and traditional wildlife usage would be severely lacking for the longest time of all of the alternatives.

If establishment is delayed due to lack of seed or other causes, ponderosa pine-dominated conifer establishment may be delayed until another seed year and ground disturbance event occur simultaneously. Stand establishment when modeled to include 10 trees per acre naturally becoming established does not show the stand canopy closing within 100 years. This does not meet management objectives to manage for late successional development of large diameter stems, snag recruitment and crown closure, all of which are integral parts of owl and eagle Habitat. This also does not meet the reforestation direction given to establish viable growing seedlings in areas deforested following fires (Goodman 2002; Paulson 1992).

Leaving high levels of dead trees where the Davis fire caused high mortality would increase the fuel loading to an extreme level rating of resistance to control (Brown et al 2003). This increased level would continue for the next century unless subsequent fires or interim fuels treatments are conducted. Downed wood would decay at slower rates due to being elevated by other pieces on the ground. Low levels of regeneration of lodgepole pine would

occur and grow although susceptibility to fire would persist in the area through the next century, provided subsequent fire(s) does not enter the stand. The lag time between the last large snag falling and the next snags recruited would be longer than in planted stands by at least 50 to 100 years (Sessions 2003; Everett 1999). Fire would be able to carry through the area after 10 years at which time the ability to control a fire in the heavy fuels present would be very difficult and costly (Brown 2003).

It is not expected that any intermediate management treatments would be conducted because there would not be a manageable stand. Where stands develop dense enough to require intermediate management, perhaps near the edges of the fire, thinning would not be practical because adjacent areas would be fire-prone and there would be no way to protect the thinned stands from wildfire when it occurs.

Based on modeling runs, large diameter trees would not be available for snag recruitment for about 150 years. Trees available would be mostly lodgepole pine that would be available for about a century due to the short life span of that species (Franklin 1973). The naturally established stands would be stocked with mostly lodgepole pine which would not provide continuous on-site large snag availability over the multiple centuries as occurs with most of the other conifer species in the area (Everett 1999). Initially, other isolated conifer species, predominantly ponderosa pine and/or Douglas-fir, would be expected to regenerate from seed scattered very widely around the intensely burned areas. Any increase in these non-lodgepole species would be slow at best as long as fuel loadings and/or brush were allowed at levels high enough to kill the establishing seedlings/saplings/poles. This would reset the stands to the isolated lodgepole pine regeneration with its shorter life cycles and could take up to 200 years for the other species to attain dominance of the site (Agee 1993).

Fire suppression in the area would be mostly ineffective for fires starting in annual dry conditions until they burned into adjacent areas with managed fuels. Brush fields and associated species, along with lodgepole pine, would dominate the site into the next century with white fir, ponderosa pine, Douglas-fir and some Shasta red fir slowly becoming established under the brush.

Under this alternative it is not anticipated that habitat conditions of mixed conifer old growth or stands with conditions for the spotted owl would develop until an early seral species structure is established that is resistant to fires.

Reforestation -- Common to all Action Alternatives

Reforestation on the ponderosa pine and mixed conifer plant associations is required to achieve management goals for the areas (Deschutes Forest Plan) and to follow National Forest Management Act (NFMA; see pages 1-4 of DEIS) and Regional office direction (Goodman 2002). Minimum stocking levels for ponderosa pine sites are directed to be 125 trees per acre of free to grow seedlings (Draft Stocking Levels 1994; Oregon State Forest Practices Act 2003). Though the State direction does not affect National Forest management, it has been used as guidelines. As stated earlier, the deforestation caused by the fire is outside the historical range of variability in that there historically were not large stand replacement fires in the ponderosa pine plant associations or mixed conifer dry sites (Brown & Smith 2000), and the stand replacement fires which did occur left some ponderosa pine trees within the stands to disseminate seed (Arno 1995). The fire which went through this area in 2003 removed tree canopies over a large area and left no seed trees.

Ponderosa pine seed is transitory and does not remain viable long after its initial year. Transient seed is typically found on the surface of the duff and was thus consumed when the duff was volatized. Transient seed left on the site will be low. This seed includes many of the annual grasses and forbs as well as the coniferous trees. Persistent seed on these sites is expected to be mostly ceanothus, chinquapin, bitterbrush and manzanita (Schopmeyer 1948; Brown & Smith 2000; Volland 1985). Revegetation is also expected from plants which have reproductive tissue in the soil which includes perennial forbs and grasses, including sedges, fescue. Ceanothus and chinquapin also tend to sprout from surviving root crowns. The revegetation of these species will reduce the ability of ponderosa pine to reforest the site (Volland 1985). Grass and brush can be expected to dominate the site for more than four or five decades without artificial regeneration of ponderosa pine, sugar pine, Douglas-fir, and Shasta red fir from locally adapted seed. Local seed is used for all species in reforestation following guidelines for seed transfer rules within seedzones. Most seed will be collected within the Crescent District though some may come from northern districts within the breeding zone. Regenerated western white pine will be from trees which were progeny of trees selected for blister rust resistance.

Modeling of stand characteristics using FVS has shown that planting of ponderosa pine seedlings at 200 trees per acre, considering 90% survival and some in growth of natural trees, the stands will have crown closure over 30% within 40 years and average stand diameters of 6 to 9 inches diameter breast height. Stands without planting and modeled with some reforestation of 10 trees per acre per decade would have crown closures of 4%-5% and diameters of 4-6 inches dbh. This natural regeneration estimate is high for the area except along the fire perimeters and within mixed lethal fire area. In other areas of previous disturbance no trees are found where there is no seed source within a couple hundred feet.

To be effective, reforestation in ponderosa pine and mixed conifer plant associations typically may need protection from large game and/or small mammal damage. These damages may occur soon after planting and the following decade depending on the weather patterns and animal population dynamics. Protection from these animals is compounded by slow growth due to competing vegetation. Seedlings growing slowly due to competition from brush and grass take more years to grow large enough to not be impacted by animals. The more damage to seedlings, the less chance of survival. Reducing the impact of competing vegetation is critical in the first few years of seedling establishment and can be reduced by planting healthy seedlings, establishing trees immediately following disturbance. Open ground planting in Central Oregon allows trees to be exposed to high surface temperatures around the root/stem interface. This phenomenon can decrease survival and growth of planted seedlings (Cleary 1978; Sexton 1998). Protection from big herbivorous animals will include repellents applied every year (BGR). Protection from rodents can be accomplished with traps. Reducing soil temperatures impacting seedlings can be reduced through micro site planting of seedlings in the shade of remaining logs, stumps or other objects. All of these treatments can be used with each other to quickly establish a stand of fire adapted conifers on dry sites where otherwise a stocked stand will not be established within the next few decades. Expected treatment acres are as follows Alt. B and C 1,712 acres BGR and 1,245 acres gopher trapping; Alt. D no BGR or gopher trapping; and Alt. E 505 acres BGR and 1,075 acres gopher trapping.

Reforestation within the Davis Fire area is planned to meet the needs of wildlife and the ecosystem as well as NFMA requirements. Within ponderosa pine plant associations, reforestation will be through planting strictly ponderosa pine at a level that will produce 170 – 200 trees per acre free to grow after 5 years. In the lodgepole pine areas planting will be conducted only in areas requiring cover and protection for deer and elk, and where ponderosa pine can be established for future bald eagle management. Planting for elk cover will be dense lodgepole pine on the perimeters up to 300 trees per acre but only 170 – 200 trees per acre on the inner portions of the plantations. Bald eagle management areas will be planted to provide 170-200 trees per acre. These will require microsite planting to reduce animal browse and possible frost heaving. Mixed conifer sites will receive varying amounts of species diversity depending on actual plant association and aspect. Drier plant associations will be planted to produce 170 –200 trees per acre of 75% ponderosa pine and 25% Douglas-fir. As the elevation increases in these plant associations the ratio will be 60% ponderosa pine, 20% Douglas-fir and 20% sugar pine. Further elevation increases will be planted to produce 50% ponderosa pine 20% sugar pine, 20% western white pine and 10% Shasta red fir. This variation will emulate the historical condition. It is expected that with exclusion of fire in areas white fir and lodgepole pine will become established in the next century to levels found before the fire. Where prescribed fire is maintained the stands will remain with the species planted with variable levels of mortality.

A desired stocking level of 170-200 trees per acre was selected for much of the area to meet a wide range of resource objectives. These include, in order of their development over time, large game cover and travel corridors, spotted owl dispersal habitat, timber values within Matrix lands, and large diameter tree and snag potential. The level of stocking was chosen with the expectation of a loss of trees due to initial seedling mortality, mortality due to animal damage, and subsequent prescribed fire. Following initial prescribed fire application, survival of the stands can be evaluated and desired stands or tree characteristics can be selected. This should occur in the third or fourth decade following establishment. At that time areas or stands which will be best placed for dispersal habitat can be left at denser stocking. Stands can be thinned to levels which will develop the large tree architecture typical of more open-grown trees where it is desired. Jerry Franklin, in his comment on the Biscuit Recovery EIS, mentioned that "establishment of dense, uniform stands is completely inappropriate in the LSRs and on any PAG identified as fire regime types I and II" (Franklin 2004). Reforestation at rates of 200 trees per acre is not considered dense because regenerated stands which are not treated will not be developing an intermediate tree component until the average stand diameter is more than 8" dbh (Cochran 1994). Reforestation in this context will have variability following prescribed fire because fuels treatments, unlike customary thinning treatments, will not leave a uniform level of fuels. Franklin proposes variability in planting where the plan here is to introduce variability in the

survival or established trees. Establishing a stand is more difficult than modifying the density of an established stand.

Alternatives B and C

These alternatives will salvage timber, treat fuels, and reforest areas within the Davis Fire Area. Ground-based logging systems are most extensive in Alternative B; more units are prescribed for advanced harvest systems in Alternative C. The difference in logging methods will not change the expected development of forest vegetation.

Direct and Indirect Effects

Alternatives B and C will develop healthy stands of mixed species that will provide for future forest needs including timber values, large diameter trees for wildlife habitat and large snag recruitment and will accelerate recovery of dispersal habitat. Stand modeling and analysis show crown closure at 40 years to be estimated at 38% on average, with overstocked stands requiring thinning; and at 100 years, crown closure at 56% throughout the high mortality areas of the fire. Dispersal habitat for spotted owls is considered above 30% crown closure.

Analysis also shows at 40 years a stand of mixed planted species at an average of 7.5 inches dbh. Stocking of these species will be between 170 and 200 trees per acre with additional lodgepole pine and Douglas-fir trees becoming established where adjacent to seed sources. Modeling 100 years out following the fire shows an average tree diameter of 14 inches dbh and crown closure of 56%. This provides for large diameter snags especially if stocking control and prescribed fire measures are taken earlier in the stand history to develop larger diameter trees. This also provides for dispersal habitat for spotted owls and associated wildlife species where stocking control measures are not taken. Diversity will be provided through the untreated 15% of each treatment unit where neither salvage nor planting occurs, as well as the areas of low intensity fire where stands will have high variability in survival and stand composition.

These alternatives will develop stands that are fire adapted. The species planned for reforestation throughout the fire area will vary for each plant association depending on the natural occurrence (see silviculture prescription, table 3.41). Species planted will include ponderosa pine, Douglas-fir, sugar pine, Shasta red fir, western white pine, and lodgepole pine (in the Key Elk Area). Natural regeneration will be dominated by lodgepole pine. Ponderosa pine is considered highly resistant to fire mortality (Flanagan 2001). Other species planned and which will naturally be established are less resistant to fire mortality; however, through fuels reduction any fire which occurs will be less intense than if all fuels were retained (Brown 2003). The stands which develop following this action will be resistant to mortality in light and moderate fires.

Alternatives B and C will reduce fuel loadings to allow future introduction of prescribed fire and future fire suppression. Fuels which accumulate from snag fall down have three ways of being reduced: they can be removed, decay, allowed to burn. In this alternative, salvage will remove much of the large fuels on the site. Following salvage treatments fuels treatments will be conducted where necessary and will include small diameter snag felling and piling (in ground based harvest units) followed by burning of fuels concentrations (jackpot burning). This treatment addresses concerns of increased short term fire hazard following salvage of fire killed timber. Analysis of fuel loadings due to snag fall down of the dead trees following planned treatments shows fuel levels in treated stands will accumulate to an average level of 25 tons per acre in forty years. This will be variable across the units with areas left with no treatment and areas where jackpot burning removes the majority of the fuels. To allow prescribed fire to be reintroduced, levels below 15 tons per acre are considered safe. Fuels levels above 25 tons per acre are considered high resistance to control yet should not lead to unusually severe fire effects (Brown 2003).

In Alternative B the regenerated stands may need intermediate treatments depending on resource objectives. Active management and restoration of ponderosa pine and mixed conifer stands should be done in conjunction with fuels treatments. Management activities beginning in the third decade can be expected. These treatments will be needed to meet other future objectives of the area. Thinning will be used to develop faster growing large trees at various densities. Along perimeters of the fire and units adjacent to mixed severity fire areas stocking levels may be very high in the third decade due to lodgepole pine regeneration. To maintain desired species, non-commercial thinning will be needed in these stands to reduce the exclusion of shade intolerant species. When the dominant trees in the

stands average 12" dbh (30–50 years) prescribed fire should be used to manage fuels levels and mimic frequent low intensity fires. This may be conducted in conjunction with thinning some stands or following older thinning to varying densities to promote large diameter trees with late-successional objectives or cover for owl dispersal habitat. Mortality to shrub layers can be expected to begin as crown closure rises to 30% (4th decade) this will assist in the use of prescribed fire and increase the hazard from wildfire.

Over the landscape there will be various stand characteristics, with areas that received no salvage treatment being mostly brushfields, various thinned areas, and areas which receive prescribed fire treatments and show various levels of mortality and growth differentiation (Arno 1995). Reforestation at rates of 200 trees per acre is not considered overly dense because regenerated stands will not be developing an intermediate tree component until the average stand diameter is more than 8" dbh (Cochran 1994). Variability through the area at a landscape level will be high because of the areas that remain untreated, including areas of mixed intensity fire. Through the moderate and high fire intensity areas we do not expect to have large uniformly stocked stands. Variability will occur with planting survival, species selection, use of prescribed fire, and untreated areas (see page 3-152 for a description of species mix and reforestation objectives; see table 3.40 for prescription by MSA). Initial establishment of a stand is more difficult than modifying the density of an established stand to meet management objectives.

Fire may be used at varying frequencies in the regenerated units, within the mixed conifer and ponderosa pine plant associations, to meet fuels and wildlife objectives of developing ponderosa pine and fire dependent ecosystems. Wildfires which begin in the Davis Fire Area will be suppressed or managed depending on resource objectives. Fires which occur where fuels treatments or salvage did not occur, including the lodgepole pine and mountain hemlock plant associations will be very difficult to suppress and will need to be controlled from safer locations such as stands where fuels have been managed. These fires will be of high intensity which cause stand replacement events again but in smaller areas than occurred in the Davis Fire of 2003. Wildfires which occur in ponderosa pine and mixed conifer managed stands where salvage and fuels treatments have reduced fire hazard will be light fires which cause light mortality in areas but do not have a high resistance to control.

Larger diameter trees (20" diameter breast height) will be on the regenerated sites within 80 years. Depending on intermediate treatments (e.g. thinning, prescribed fire) a broad range of species and diameters will be available to become snags.

Cumulative Effects

Surrounding the Davis Fire area, silviculture treatments, including thinning and fuels reduction, will continue. The Seven Buttes Return project of understory density reduction through thinning and fuels treatments is expected to be implemented. Recreation and Watershed improvements are expected to continue in the Davis Lake and Wickiup Reservoir areas.

Spotted owls generally require mature or old-growth coniferous forest with complex structure including multiple canopy layers, large green trees and snags, heavy canopy habitat, and coarse woody material on the forest floor. Characterized as Nesting, Roosting, Foraging (NRF) habitat, it is usually the limiting habitat attribute, especially on the Eastside of the Cascades where sustainable forests are generally influenced by fire and typically less dense than Westside forests.

The Deschutes National Forest has lost approximately 17,500 acres of NRF over the last two years to wildfire (Joint Aquatic and Terrestrial Programmatic Biological Assessment for Federal Lands Within the Deschutes Basin 2003-2006). With a total 2004 baseline of 94,000 acres, this is about a 19% loss. Recent projects on the forest designed to manipulate these NRF stands to retain big trees and to maintain a multiple canopy includes Seven Buttes and Charlie Brown. Totaling approximately 3,500 acres, the purpose of the majority of these acres is to reduce the risk of loss to a large event (insects, disease, or wildfire). Although the vegetative prescriptions reduces the level of understory competition in these stands to a level that no longer meets the habitat components for NRF, many of these stands would be classified as suitable NRF habitat once again in one to two decades. Another likely foreseeable action that proactively manages vegetation adjacent to the Davis Fire area in NRF stands would be a project that is currently proposing active management on approximately 4,000 acres.

The intent of LSRs is to protect and enhance the condition of late-successional/old-growth forest ecosystems, which serve as habitat for dependent or old growth associated species including the northern spotted owl. The LSR network in the Pacific Northwest covers three major mountain ranges: the Cascades, the Klamath, and the Coast

Ranges including the Olympic Peninsula. Together they roughly form an "H" configuration. The east leg joins the Sierra Nevada in California to the Siskiyous, and north to the Cascades. Eleven LSRs are designated within the Upper and Little Deschutes subbasins on the Deschutes National Forest.

Connectivity between LSRs is necessary to provide demographic viability and genetic diversity should stochastic events (e.g., fire, insect, disease, wind storms, inclement weather) significantly reduce the population in any individual LSR. The Northwest Forest Plan, in theory, provides for connectivity between each LSR by utilizing Riparian Reserves, Administratively Withdrawn Areas, Wild and Scenic River corridors, 15% green tree retention areas, and 100-acre owl activity centers for those sites that are outside of the LSRs. This theory may be valid for westside conditions, but not for the dry eastside forests found on the Deschutes NF, where riparian areas are lacking or widely dispersed, and Wild and Scenic River corridors are limited. All but six owl activity centers are accounted for within LSRs or Congressional Reserved Areas. Generally, dispersal habitat across the Deschutes NF is fragmented by roads, timber harvest units, or by areas that have been burned or defoliated by insects or disease. The Davis Fire has caused further fragmentation to the Davis Late Successional Reserve and adjacent reserves.

Proposed active management within the Davis Fire (also within the Reserve) for Alternatives B, C, and E would accelerate attainment of NRF up to 4,000 acres, or 4% of the existing baseline. One of the most critical elements for NRF is large trees of suitable species such as Douglas-fir and ponderosa pine. With active management, stands averaging 14" diameter at chest height are present with the species necessary for long term LSR objectives. Passive management would result in average stand diameters of 10" diameter at chest height comprised of lodgepole pine. Implementation of these alternatives would potentially accelerate NRF habitat online within the fire area by one hundred years (reference vegetation section), providing connectivity to adjacent reserves.

Alternative D

Salvage, fuels reduction, and reforestation are conducted in stands outside of the Davis LSR; except for reforestation in the key elk area to provide cover habitat and small-diameter fuels reduction along Highway 46 and around developed recreation sites, and other strategic areas (see map #10 and #11). Effects for Alternative D will be similar to those described for Alternative A (No Action) within the LSR and similar to Alternatives B and C in the Matrix; therefore the effects discussion is divided into LSR and non-LSR.

Direct and Indirect Effects

Non-LSR: The recovery of dispersal habitat will be accelerated. Analysis shows crown closure at 40 years to be an average of 38% with stands in need of density management; and crown closure at 100 years to be at 56% throughout the reforested area.

Outside the LSR this alternative will develop a mixed-species healthy stand which will provide for future forest needs including timber value, large diameter trees for wildlife habitat and large snag recruitment. Where reforestation will occur, stand modeling and analysis for this alternative shows at 40 years a stand of mixed species at an average of 7.5" dbh. Stocking of these species will be between 170 and 200 trees per acre with some lodgepole pine and Douglas-fir becoming established in some stands (adjacent to seed sources). Modeling 100 years out following the fire estimates are of an average stand diameter of 14 inches dbh and crown closure of 58%. This provides for large diameter snag recruitment especially if stocking control measures are taken earlier in the stand history to develop larger diameter trees.

LSR: Inside the Davis LSR, areas not reforested will not develop a mixed species healthy stand to provide for future forest needs including large diameter trees. Where no reforestation will take place, analysis shows average crown closure at 40 years to be below 10% and at 100 years less than 22% throughout the high mortality areas of the fire. Dispersal habitat for spotted owls is considered above 30% crown closure.

Within the Davis LSR (where no reforestation occurs) stand modeling and analysis for this alternative shows at 40 years a stand of predominantly lodgepole pine with some Douglas-fir at an average of 5" diameter breast height. Stocking of these species will be less than 70 trees per acre. Modeling 100 years out following the fire estimates

are of an average stand diameter of 10 inches dbh and crown closure of 20%. This does not provide for large diameter snags or dispersal habitat for spotted owls and associated wildlife species.

Table 3.72 compares stand characteristics inside and outside of the Late Successional Reserve expected under Alternative D.

Table 3.41 Comparison of Effects for LSR and Non-LSR stands in Alternative D

	Allocation	
	LSR	**Non-LSR & Eastside**
Moderate and High Intensity Fire Area	9,732	4,364
Acres of Salvage and Reforestation Alt. D	0 (0%)	1,045 (24%)
	on 9,732 acres of untreated stands:	***on 1,045 acre of treated stands:***
Stand Characteristics at 40 years	10% canopy closure 5" average dbh Mostly lodgepole pine 70 trees per acre	38% canopy closure 7.5" average dbh Species depends on Rx (see Table 3.40) 170-200 trees per acre
Stand Characteristics at 100 years	22% canopy closure 10" average dbh lodgepole	56% canopy closure 14" average dbh mixed conifer

This alternative will not develop stands of fire-adapted species within the Davis LSR; however it will develop fire adapted species stands outside the Davis LSR where reforestation is planned. The species anticipated for initial natural regeneration throughout the fire area in all plant associations will be dominated by lodgepole pine. Douglas-fir and lodgepole pine will become established in much of the mixed severity fire areas which have openings. The stands which develop following passive management will be susceptible to high mortality when the area reburns after the first decade for at least 60 years (Brown. 2003). On the 2,030 acres to be reforested, the species planted will vary for each plant association depending on the natural occurrence. Species planted will include ponderosa pine, Douglas-fir, sugar pine, Shasta red fir, western white pine, and lodgepole pine (in the Key Elk Area). Natural regeneration will be dominated by lodgepole pine. Ponderosa pine is considered highly resistant to fire mortality (Flanagan 2001). Other species planted and naturally regenerated are less resistant to fire mortality. The stands which develop following this action within the Davis LSR will not be resistant to mortality in light and moderate fires.

This alternative will not reduce fuel loadings to allow future introduction of prescribed fire and future fire suppression in the LSR. In this alternative salvage will remove much of the large fuels in treated stands in the Matrix allocation, but will not throughout the Davis LSR. Following salvage treatments fuels treatments will be conducted where necessary and will include small diameter snag felling and piling (in ground based harvest units) followed by burning of fuels concentrations (jackpot burning). Within the Davis LSR only strategic fuels treatments to prevent the spread of fire out of the low areas into mixed conifer-dominated stands will be conducted (see map #10). These fuels treatments will reduce the ability of fire to spread into the mixed conifer areas of the Davis fire but they will not assist in the reduction of spread within the fire area.

Analysis of fuel loadings due to snag fall down of the dead trees following salvage and fuels treatments shows fuels levels in treated stands will accumulate to an average level of 22 tons per acre in forty years. This will be variable across the units with areas left with no treatment and areas where jackpot burning removes the majority of the fuels. Within the untreated and non-salvaged stands fuels levels will be much higher with an average of 50 tons per acre. To allow prescribed fire to be reintroduced levels below 15 tons per acre are considered safe. Fuels levels above 25

tons per acre are considered high resistance to control and will likely cause high mortality of the stand for at least the next 60 years (Brown 2003).

Direct effects of Alternative D are high levels of standing snags, and stocking of high mortality areas of the Davis fire with brush and grasses. Little regeneration of conifer species would occur in these areas. Salvage and reforestation outside the Davis LSR would reduce fuels levels and leave large snags. Early seral fire resistant species would be established along with some natural regeneration of lodgepole pine and heavy brush. Within the Davis LSR there will be increased insect populations of bark beetles and wood boring species due to leaving all classes of dead trees.

The indirect effects of leaving high levels of dead snags where the Davis fire caused high mortality is increased fuel loading to an extreme level rating of resistance to control (Brown 2003). This increased level will continue for the next century unless interim fuels treatments are conducted. Downed wood will decay at slower rates due to being elevated by other pieces on the ground. This may also hinder big game travel through the area. Low levels of regeneration of lodgepole pine will occur and grow, though susceptibility to fire will persist in the area through the next century. The lag time between the last large snag falling and the next snags recruited will be longer than in planted stands by at least 50 years and could take up to 100 years longer (Sessions 2003; Everett 1999). Fire will be able to carry through the area after 10 years at which time the ability to control a fire in the heavy fuels present will be very difficult, costly and cause high mortality (Brown 2003).

It is not expected that any intermediate management treatments will be conducted because there will not be a manageable stand. Thinning will not occur due to the lack of trees and where dense enough stands occur it would not be practical since there would be no way to protect the stands from wildfire when it returns.

Cumulative Effects

With Alternative D, areas that experienced high/moderate intensity fire in the Davis LSR will not have large diameter trees available for snag recruitment for about 150 years. This is about 97% of the LSR in the fire area. Trees available in these areas will be lodgepole pine and will be available for less than a century due to their short life span (Franklin 1973). The naturally-established stands will be stocked with mostly lodgepole pine which will not provide continuous on-site snag availability over the multiple centuries as occurs with most of the other conifer species in the area (Everret 1999).

Fire suppression in the area will be mostly ineffective for any fire which starts in annual dry conditions until it burns into managed fuels areas. Brush fields and associated species will dominate the site into the next century with white fir and some Shasta red fir becoming established under the brush.

Under this alternative it is not anticipated that habitat conditions of old growth or conditions for the spotted owl will develop until it is replaced with an early seral species stand that is resistant to fires which occur in these ecosystems.

Recent Discussions on Passive versus Active Management

Jerry Franklin's Comments on the Biscuit Fire DEIS

Jerry Franklin is professor of Ecosystem analysis, College of Forest Resources from the University of Washington in Seattle. Professor Franklin was part of the Forest Ecosystem Management Assessment Team (FEMAT) in 1993 that ultimately was used in the drafting of the Northwest Forest Plan Record of Decision in 1994. Professor Franklin provided comments to the Biscuit Fire EIS on the Siskiyou and Rogue River National Forests.

The Biscuit Fire, located in southern Oregon and northern California, began on July 13, 2002 and reached 499,965 acres. Estimated to be one of Oregon's largest in recorded history, the Biscuit Fire encompassed most of the Kalmiopsis Wilderness. The boundary of the Biscuit Fire stretches from 10 miles east of the coastal community of Brookings, Oregon; south into northern California; east to the Illinois Valley; and north to within a few miles of the Rogue River.

In his comments specific to the Biscuit Fire, Professor Franklin asserts salvage logging in Late Successional Reserves does not contribute to the revival of forest habitat and that it is antithetical to the recovery process. He also states that the Late Successional network was designed to accommodate large, intense natural disturbances and

allow for natural recovery processes. Further in his comments on page 5, he states "one might question the appropriateness of allowing natural recovery processes to proceed if stand-replacement fire behavior with the resulting high levels of fuels were not characteristic of the LSRs".

It should be noted that the 1994 Final Supplemental Environmental Impact Statement which resulted in the Northwest Forest Plan relied heavily on the Forest Ecosystem Management Assessment Team report (FSEIS, 1994, page 3 & 4-3). In the Record of Decision for the Northwest Forest Plan, additional analysis was used to design the Late Successional Reserve system to "achieve the biological results required by law, while minimizing adverse impact on timber harvest and jobs (ROD, 1994, page 26)." The FEMAT report acknowledged that the approach for adaptive management should be an objective in forest management as new or more complete science becomes available as we learn how the forest stands respond to environmental conditions that were impossible to forecast. Also, on page ii, the report acknowledges that the social and economic needs of humans should be considered.

The path chosen for the Biscuit Fire project may or may not be the best course of action for the Davis Fire. To let natural processes proceed may not be as appropriate. Agee recognized this point in his article in "Conservation Biology In Practice," winter 2002, that passive management on the eastside forest LSRs over a century could potentially lead to losses of over half of the reserves in that time frame due to stand replacement fires and insect attacks, leaving no old growth characteristics.

Franklin also acknowledges eastside systems may function differently from westside forest ecosystems. In the fall edition of "Issues in Science and Technology Online," Agee and Franklin coauthored an article that quotes: "Uncharacteristic stand-replacement fires in dry forests can produce uncharacteristic levels of post-fire fuels, including standing dead and down trees. Removing portions of that particular biological legacy may be appropriate as part of an intelligent ecological restoration program, and not simply as salvage." They recommend that any management for fuels and ecosystems should be science based, which this analysis is.

Also recently, the rate of loss of habitat including connectivity to the Late Successional Reserve system on the Deschutes National Forest and adjacent Forests may indicate a need for more active management. Especially for protection for remaining Nesting, Roosting, and Foraging (NRF) habitat for the northern spotted owl (see Cumulative Effects to Northern Spotted Owls section, page 3-217).

Two important points made in Agee's comments on passive management are "The hard lesson that we should take away from the last decade of fire management in drier forests, particularly in the North American West, is that a choice to do nothing is a choice of action, not always one with a desirable outcome." He also recommends "In order of priority treatment should focus on surface fuel, ladder fuel, and then crown fuel." (Agee 2002a).

Timothy Ogden Sexton's Masters Thesis "Effects of Post-wildfire Management Activities on Vegetation, Composition, Diversity, Biomass, and Growth and Survival of Pinus ponderosa and Purshia tridentata"

Mr. Sexton, in pursuit of his Master of Science in Rangeland Resources for Oregon State University, presented this thesis in 1998 for a partial fulfillment of requirements. His conclusion is that salvage logging or active management on the post-fire landscape, retards the re-establishment and early growth of ponderosa pine (*Pinus ponderosa*) and bitterbrush (*Purshia tridentate*) as studied for the 1992 Lone Pine Wildfire on the Winema National Forest.

A follow up report was completed five years later compiled by Sarah Malaby (forest Botanist for the Fremont and Winema National Forests) in December 2002. This report summarizes data collected in 1999 in permanent plots established in the Lone Pine Fire study area and compares the 1999 results to previous years' results (Sexton, 1998). In Sexton's thesis, only tree height in 1994 was statistically greater in unplanted control plots compared to unplanted salvage plots. However, this had a p-value of 0.2 which does not provide enough evidence to reject the null hypothesis (Triola 1997) and should not be considered statistically significant. In addition, this data was preliminary because it only included 1 to 2 seasons of regrowth. Continued research on these same plots 6 to 7 years after the salvage show no statistical difference between control plots or treatment plots regardless of planting (Malaby 2002). However, when natural and planted control plots were compared to natural and planted salvage plots, tree density, height, and diameter were significantly greater (p 0.01 for diameter, p 0.1 for density and height) in planted plots than in naturally regenerated plots. This supports the Forest Service assumption that revegetating salvaged units with 3 to 4 year old conifers would give these areas a "head-start" on evapotranspiration recovery.

The effect of proposed salvage operations on cover values would be twofold. The use of ground-based machinery would disturb established vegetation on implemented skid trails and landings, the extent of which, combined with off trail, out and back passes of an excavator, would be approximately 20% of an activity area. At the same time, the felling and yarding of material would move organic woody branches and smaller boles to the ground. Effective cover values would not be expected to change significantly as a result of these two effects. Disturbance resulting from these operations would also not be expected to slow the continued growth of vegetation established on the site. Cover values of shrubs (PUTR = 25%) and biomass production (herbaceous species = 387 kg/ha) on salvaged areas in the Lone Pine fire years were not statistically different than un-salvaged controls and had additional cover provided by planted and naturally regenerated conifers (Malaby 2002). Based on information from these studies, effective cover values on acres proposed for treatment would be of sufficient levels to meet Forest Plan Standards and Guidelines for Soil quality (SL-6) within two years following implementation of activities. The survival and growth of seedlings in open ground on the eastslope of the Cascades has been recognized for some time. The root/stem interface at the soil surface is known for high heats in direct sun on reflective soils. To improve growth and survival a common practice not conducted in Sexton's plots is to microsite seedlings to partially shade the tree stems at the soil surface.

Alternative E

Alternative E will salvage and treat fuels on less area than Alternatives B or C (approximately 50% less). The salvage and treatments will be concentrated on areas proposed for helicopter salvage because of steeper slopes or more visually sensitive areas. These areas are concentrated along the Cascades Lakes Highway (Highway 46) and on the slopes of four of the buttes in the Davis Fire area. After salvage, fuels reduction will occur with hand piling and pile burning in the units adjacent to the Cascade Lakes Highway and whip falling and burning of concentrations on the rest of the salvage areas.

This alternative will accelerate recovery of dispersal habitat for wildlife within salvage and reforested areas. Reforestation by planting is proposed in 250 acres of older managed stands ("plantations") scattered through the mixed conifer and ponderosa pine moderate and high intensity fire areas. This reforestation will develop scattered stands of dispersal habitat. Analysis shows average crown closure at 40 years to be estimated average of 38% and overstocked causing mortality without treatment at 56% at 100 years throughout the high mortality areas of the fire. Dispersal habitat for spotted owls is considered above 30% crown closure.

This alternative will develop a mixed species healthy stand which will provide for future forest needs including large diameter trees for wildlife habitat and large snag recruitment in half the acres as alternative B mostly on the slopes of the buttes in the fire area and scattered reforested stands. Conditions similar to Alternative A will occur in the lower, drier slope areas below and between Davis and Hamner Buttes. Analysis for this alternative shows a stand of mixed planted species at an average of 7.5" diameter breast height in salvage and planted areas at 40 years. Stocking of these species will be between 170 and 200 trees per acre with some lodgepole pine and Douglas-fir becoming established in some stands (adjacent to seed sources). Modeling 100 years out estimates are of an average stand diameter of 14 inches dbh and crown closure of 58%. This provides for large diameter snags especially if stocking control measures are taken earlier in the stand history to develop larger diameter trees. This also provides for dispersal habitat for spotted owls and associated wildlife species where stocking control measures are not taken. Diversity of habitat will be provided within the 15% retention areas of each unit, and the rest of the untreated fire area (low, moderate, and high intensity).

This alternative will develop fire adapted species stands in half the acres as alternative B mostly on the slopes of the buttes in the fire area and scattered reforested stands. The species planned for reforestation throughout the fire area will vary for each plant association depending on the natural occurrence. Species planted will include ponderosa pine, Douglas-fir, sugar pine, Shasta red fir, western white pine, and lodgepole pine (in the Key Elk Area). The amount of area which historically would develop as ponderosa pine will be less than in Alternatives B and C with less low elevation drier types being salvaged and reforested in this alternative. Natural regeneration will be dominated by lodgepole pine. Ponderosa pine is considered highly resistant to fire mortality (Flanagan 2001). Other species planted and which will naturally be established are less resistant to fire mortality however through fuels reduction any fire which occurs will be less intense than if all fuels were retained (Brown 2003). The stands which develop following this action will be resistant to mortality in light and moderate fires.

This alternative will reduce fuel loadings to allow future introduction of prescribed fire and future fire suppression by salvaging on 3,290 acres and small fuels reduction on 1,450 acres. Fuels which accumulate from snag fall down have three ways of being reduced. They can be removed, decay or burned. In this alternative salvage will remove much of the large fuels on the site. Following salvage treatments fuels treatments will be conducted where necessary and will include small diameter snag felling followed by burning of fuels concentrations (jackpot burning). This treatment addresses concerns of increased short term fire hazard following salvage of fire killed timber. Analysis of fuels loadings due to snag fall down of the dead trees following planned treatments shows fuels levels in treated stands will accumulate to an average level of 25 tons per acre in forty years. This will be variable across the units with areas left with no treatment and areas where jackpot burning removes the majority of the fuels. The areas between Hamner and Davis Buttes which will not be salvaged or have fuels treated will have high levels of fuels similar to those in alternative A at an average of 50 tons per acre. These fuels will be continuous through this untreated area. To allow prescribed fire to be reintroduced, fuels levels below 15 tons per acre are considered safe. Fuels levels above 25 tons per acre are considered high resistance to control yet should not lead to unusually severe fire effects (Brown 2003). As has been mentioned the mixed conifer and ponderosa pine plant associations within the Davis fire are not within the historical range of variability for fuels loadings.

Direct effects of Alternative E are moderate to high fire hazard through the treated areas for the next five to seven decades and then decrease through decay of the fuels. There would be high to extreme levels of fuels in the mixed severity fire which receive no fuels treatments and 15% of the treatment units which are not salvaged. Fires will have little chance of spread for the first decade (Brown 2003).

In Alternative E the regenerated stands may need intermediate treatments depending on resource objectives. With active management and restoration of ponderosa pine and mixed conifer stands in conjunction with fuels treatments, management activities beginning in the third decade can be expected. These treatments will be needed to meet other future objectives of the area. Thinning will be used to develop faster growing large trees at various densities. Along perimeters of the fire and units adjacent to mixed severity fire areas stocking levels may be very high in the third decade following establishment of lodgepole pine regeneration. To maintain desired species precommercial thinning will be needed in these stands to reduce the exclusion of shade intolerant species. When the dominant trees in the stands average 12” diameter breast height (40–50 years) prescribed fire should be used to manage fuels levels and mimic frequent low intensity fires. This may be conducted in conjunction with thinning some stands or following older thinning to varying densities to promote large diameter trees with late-successional objectives or cover for owl dispersal habitat. Mortality to shrub layers can be expected to begin as crown closure rises to 30% (4th decade) this will assist in the use of prescribed fire and increase the hazard to wildfire. Over the landscape there will be various stand characteristics with areas which have received no salvage treatment which will mostly be brushfields, various thinned areas, and areas which receive prescribed fire treatments and show various levels of mortality and growth differentiation (Arno 1995).

Fire may be used at varying frequencies in the regenerated units, within the mixed conifer and ponderosa pine plant associations, to meet fuels and wildlife objectives of developing ponderosa pine and fire dependent ecosystems. Wildfires which begin or spread into areas which have had salvage and fuels treatments will be suppressed or managed depending on resource objectives. Fires which occur where fuels treatments or salvage did not occur, including the lodgepole pine, mountain hemlock plant associations and the area untreated between Hamner and Davis Buttes will be very difficult to suppress and will need to be controlled from safer locations such as stands which fuels have been managed. These fires will be high mortality fires which cause stand replacement events again in similar areas as occurred in the Davis Fire of 2003. Wildfires which occur in ponderosa pine and mixed conifer managed stands where salvage and fuels treatments have reduced fire hazard will be light fires which cause light mortality in areas and do not have a high resistance to control. The fires which ignite or spread into untreated areas between Hamner and Davis buttes have the potential of being high intensity fires with extreme levels of fuels. The Davis fire made a strong run between these buttes due to topography and prevalent winds. Without fuels treatment in this area fires can be expected to be more severe because of the fuels loadings. Larger diameter trees (20” diameter breast height) will be on the regenerated sites within 80 years in salvage and reforested areas. Depending on intermediate treatments (thinning, prescribed fire) a broad range of species and diameters will be available to be recruited as snags; however this will be divided into three main areas with little connectivity between the reforested areas.

Morels

Mushrooms, specifically morels (*Morchella* species) are often found in abundance the season following fire, decreasing in numbers in succeeding years. Typical sites include burned fringes and up gullies on burned, south-facing slopes. Oregon produced an estimated 900,000 pounds in 1992 (USDA PNW Research Station GTR-371, 1996). The harvest fluctuates greatly and large flushes can happen the first spring or two after fires (USDA PNW Research Station GTR-513, 2001).

Whether a fire area has a morel season can be a highly variable event. Last year, on the Sisters Ranger District of the Deschutes National Forest, the 2002 Eyerly Fire contributed to a season that sold approximately 1,000 permits (Heath Personal Communication 2004). In contrast, the 2002 Biscuit Fire on the Siskiyou National Forest had a very limited season following the wildfire event (Alliance personal communication 2004). On the Davis Fire, morels are expected to be most prolific in the mixed Conifer Plant Association Group, ranging from the Cascade Lakes Highway and higher in elevation. Fruiting is expected to closely follow the snowmelt, probably starting in late April through June, 2004.

The Crescent Ranger District prepared for the possibility of a busy season. For public safety and concerns for spread of noxious weeds, a limited entry system along major roads where hazard tree felling has occurred was incorporated into the permit system. Motorized vehicle travel and parking would not be allowed off the road system. This measure is anticipated to be effective with additional law enforcement presence. Also, ongoing monitoring for noxious weeds would continue as specified by the Burned Area Emergency Rehabilitation Report (USFS 2003d).

Buying stations would be limited to private lands located near Crescent Lake Junction. Camping would not be allowed within the fire perimeter and if sanitation or public safety is determined to be potentially affected, designated camping would be enforced.

Forest Insects

After a wildfire, there is typically a large increase in the populations of certain forest insects. Recently dead wood is colonized by a wide variety of wood boring insects and bark beetles that sometimes come from great distances to take advantage of a new and abundant food source. These insects introduce various fungi into the wood that they colonize and the fungi begin the decay process that eventually leads to the recycling of the dead material and the release of nutrients back into the system. Many of the same insects, particularly the bark beetles, will also infest trees that are not yet dead but that have been sufficiently wounded by the fire to have their defense systems impaired. In subsequent years, typically two to four years after the fire, the populations of bark beetles may become quite large and may move beyond the perimeter of the fire and infest trees that did not sustain any damage in the original fire event.

History Relative to Insect Populations in the Area

According to aerial detection survey maps, there are numerous bark beetle species that were active in 2002 in the area of the Davis Fire. These beetle populations have fluctuated greatly from one year to another in response to changes in climatic factors and the activities of other disturbance agents. For example, the drought period of the early to mid-1990s led to a substantial increase in populations of the mountain pine beetle in ponderosa and sugar pines, the western pine beetle, and fir engraver between 1993 and 1996 on the buttes surrounding Davis Lake. Once the drought subsided, these beetle populations declined to endemic levels. In 2002, however, there was an increase in most bark beetles over the levels for the previous two to three years. In particular, there was extensive fir engraver activity mapped on the south side of Hamner Butte, along with additional small pockets on the east and west sides of Davis Mountain. Douglas-fir beetle was noted on the east sides of Davis Mountain and Ringo Butte in 2002. Pockets of mountain pine beetle activity were recorded in second-growth ponderosa pine on the east side of Davis Mountain and in sugar pine around Ringo Butte. Western pine beetle was evident in several pockets of large-diameter ponderosa pine on the east side of Davis Mountain.

The Davis Fire of 2003 has provided an abundance of host material for the bark beetles that were in the area in 2002, and increases can be expected in all of the species named above.

Description of Significant Insects Related to the Davis Fire

Western pine beetle, *Dendroctonus brevicomis*

The western pine beetle is most commonly associated with large-diameter ponderosa pine and is a primary mortality agent under the right conditions. Wildfires provide those conditions that lead to rapid population increase of these beetles. The ability to complete two generations in one year enables these beetles to take advantage quickly when a food source becomes available to them. In the first and second year after the fire, the western pine beetle will colonize trees that were killed in the fire, but that still have their cambium intact and are capable of supporting the developing beetle broods. Observations from the Hash Rock Fire (Ochoco NF, August 2000) showed that western pine beetles were strongly attracted to trees with all foliage turned brown by the fire, and with 40-50 feet of blackened bole (Eglitis, in press). In past monitoring of tree survival, large pines that lose over half of their crown in a wildfire have been found to be very likely to die from attacks by western pine beetle (Miller and Patterson 1927). In years two to four after the fire, the beetles may infest pines that were weakened but still retain some live crown, or trees that are fairly healthy outside the fire perimeter. Fire-damaged trees that are being left as part of the green-tree replacement component for wildlife purposes are very likely to be killed by the western pine beetle within three to four years after the fire. Western pine beetle populations will usually decline from that point on unless other enabling factors such as drought prevail at the time.

Mountain pine beetle, *Dendroctonus ponderosae*

The mountain pine beetle is associated with numerous species of *Pinus* including lodgepole pine, second-growth ponderosa pine, western white pine and mature sugar pine. This bark beetle is commonly found on fire-damaged trees. Unlike the western pine beetle that infests trees well after a fire is over, the mountain pine beetle often responds shortly after a fire and may actually be attracted by odors emanating from burned trees (Miller and Keen 1960). The flight period of these insects (July-September) is nicely synchronized to coincide with freshly available host material provided by wildfires that tend to occur in the latter part of summer. In order to be suitable for colonization by mountain pine beetle, these damaged trees must have their cambial tissue intact. (The thickness of ponderosa pine bark usually insures that such is the case, even for trees with severe bole scorch). Infested trees are easily recognized by the thumbnail-sized globs of pitch on the bole where each point of attack has occurred.

Pine engraver, *Ips pini*

Pine engravers are also associated with lodgepole and ponderosa pines, but typically prefer trees of small diameter. On occasion they will infest and kill the tops of larger trees, producing a spike top. Fire damaged trees are attractive to *I. pini* as long as there is cambial tissue present to support the developing larvae. Within the perimeter of the fire, trees having sustained a significant level of fire damage are vulnerable to infestation by pine engravers. Outbreaks have been known to occur in green stands shortly after the fire, but are usually confined to dense stands of pole-sized trees.

Red turpentine beetle, *Dendroctonus valens*

Turpentine beetles usually confine their attacks to the basal portion of the boles of host trees (pines exclusively). The presence of pitch tubes resulting from turpentine beetle attack is an indicator that the host tree has been sufficiently wounded to produce pitch flow which serves as an attractant to these bark beetles. Although not a mortality agent *per se*, the turpentine beetle is a good indicator that the host may be vulnerable for colonization by other more aggressive bark beetles.

Douglas-fir beetle, *Dendroctonus pseudotsugae*

The Douglas-fir beetle is associated with Douglas-firs of large diameter and is known for infesting trees that have sustained light levels of fire damage (Furniss 1965). Outbreak populations typically arise a few years after the fire and, in a manner similar to the western pine beetle, can spread well beyond the perimeter of the fire.

Fir engraver, *Scolytus ventralis*

The fir engraver is best known for its dramatic population increases in response to drought. Wildfires also provide habitat for these bark beetles, and true firs sustaining even minimal fire damage (e.g., prescribed fire) may be infested afterwards by engravers (Eglitis, unpublished). However, the spread from fire-damaged trees to undamaged hosts is not as well-documented as it is for Douglas-fir beetle and western pine beetle.

Wood borers, Coleoptera: Cerambycidae and Buprestidae; Hymenoptera: Siricidae

There are three important families of wood boring insects that use recently dead wood as their food source. These include the two beetle families *Buprestidae* (flat-headed or metallic wood borers) and *Cerambycidae* (round-headed or longhorned wood borers), and the wasp family *Siricidae* (woodwasps or horntails). Most of these wood-boring insects are fairly large, measuring about one inch in length in their adult stage (beetle or wasp), with larval stages that can be considerably larger. Most of them have a one-year life cycle that begins with the adult stage in the spring or summer. Eggs are laid within the bark (beetles) or within the sapwood (woodwasps) and larvae feed for nearly a year as they grow from a small egg to a fairly large-sized grub at maturity. Both of the beetle families feed on the cambial tissue between the bark and the wood before they enter the sapwood (the woodwasps do not). The majority of wood borers infest trees that are recently dead, usually within the first year after death. Any dead tree is likely to be infested by wood borers, but as a general rule, trees killed by fires will have a higher proportion of attacks than trees dying of other causes.

Given their roles as primary decomposers, the wood boring insects are the primary reason for the sense of urgency that accompanies the salvage of fire-killed wood. All wood borers appear to have a strong association with fungi. Some of these associations may be passive (insects creating holes for fungi to enter the wood) while others are active (vectoring of a symbiotic fungus into the wood). These associated fungi are ones that produce stains and decays. It has been recognized that wood infested by woodborers decays considerably faster than uninfested wood.

The wood-boring insects are also the main reason that woodpecker populations increase dramatically in a forest after a wildfire occurs. The larvae of all wood borers are a highly prized food source for woodpeckers; their feeding can be a diagnostic tool for recognizing infested wood. *It is important to note that the woodborers arriving shortly after a wildfire are a very ephemeral food source and that their populations decrease dramatically in two or three years after the freshly dead wood is no longer available.*

Relationship Between Insects and Fire Intensity

A key factor in the habitat requirements for most bark and wood-infesting insects is that the host trees have their cambial tissue intact. This substrate is essential for the development of bark beetles, and is important in the early stages of larval development for the two beetle families of woodborers (Cerambycidae and Buprestidae). As such, the areas of "moderate burn intensity" should provide the best habitat for these insects. Where needle desiccation (rather than consumption) has occurred, the bole scorch is generally superficial and the cambial tissue has not been damaged. Most trees within the "moderate" intensity would likely be colonized at least by woodborers and possibly by bark beetles. In area of "high burn intensity", there is greater likelihood that bole scorch has been more severe and that the cambium in the lower bole in some trees has been damaged to the point where woodborers and bark beetles might not be able to establish broods. Miller and Patterson (1927) found that ponderosa pines with heavy fire damage (all foliage consumed and "sour sap" beneath the bark) were far less attractive to bark beetles than were trees with "light to medium" fire injury where crowns were either brown or had some level of needle scorch and the associated cambial layer intact. Requirements for wood boring beetles would be similar. Thus, the trees within the "high burn severity" may or may not be suitable for subcortical feeders depending on the level of damage to the cambium.

Desired Conditions for Insect Populations

Many of the forest insects such as wood borers and bark beetles are important agents in nutrient cycling, in producing the disturbances that are critical to the diversity of the forest, and in providing a food source for other organisms. As such, it is important to achieve a balance that allows for these ecological processes to continue, but that still limits insect populations to endemic levels. The populations of all of these insects are ultimately regulated by the amount of habitat (food source) that is available to them, and not by the organisms that feed on them.

Opportunities and Objectives Regarding Insect Populations

A large-scale disturbance such as a 20,000-acre wildfire temporarily disrupts the balance of insect populations in the forest and can lead to even greater imbalance without some directed effort at reducing current and potential insect habitat. Salvage harvest of recently dead and dying trees can reduce insect habitat, and to some extent the insect populations themselves, by targeting those trees that are infested at the time of the harvest, and those that would likely be the next to be infested. However, it is important to note that we do not have the ability to entirely eliminate the possibility of insect outbreaks through salvage activity because timing is critical and large areas of potential bark beetle habitat remain untreated in any project.

Environmental Consequences

Even though the manager has limited ability to avoid outbreak populations of bark beetles (the greatest forest insect-related concern that arises after a wildfire), there are some opportunities. The removal of infested trees and soon-to-be-infested host material helps to limit bark beetles populations to a certain degree. The greatest gains are with the largest infested trees; removal of small infested trees, or trees colonized two years previously have no relevance to reducing bark beetle populations from within the fire area.

The more aggressive the salvage alternative is, regarding the removal of currently infested or soon-to-be-infested trees, the greater will be the potential benefit to live surrounding stands.

Formal monitoring will be done to determine tree survival with various levels of fire damage. District personnel tagged a number of trees and recorded the level of crown and bole damage that these trees had sustained in the fire. The condition of these trees will be examined for the next five to eight years.

Relationship Between Insects and Environmental Components

The relationships between forest insects and the issues are described as follows:

- The effects of forest insects on soils and water are indirect. Trees that are killed by bark beetles will eventually fall over and, on steep slopes, may lead to increased soil movement and sedimentation into water sources.
- Within riparian areas, insects may be important contributors to in-stream wood by killing trees that grow under dense conditions in these corridors. In this way, the relationship between forest insects and Fish Habitat is indirect as well.
- The relationships between forest insects and wildlife habitat and ecosystem diversity are much more direct. As key disturbance agents, the bark beetles create gaps in the forest by colonizing and killing certain species, ages and sizes of trees that represent the most appropriate host for each beetle species. As such, these insects are directly responsible for snag levels within the forest and for their temporal and spatial arrangement.
- Wildlife habitat can be affected by insects in either positive or negative ways, depending on the species under consideration. The conversion of live trees to dead trees may be positive for some species (e.g., woodpeckers), but extensive mortality can lead to loss of cover and/or a reduction in the large-tree stand component that might be critical for other species such as the northern spotted owl.

- Bark beetles and wood borers introduce fungi into the wood they colonize and thus influence the rate at which dead wood decays and becomes usable by other organisms, either as food or as habitat.

Direct and Indirect Effects

In the short term, wood-boring insects will colonize most of the trees killed in the fire. In the larval form, the wood borers will provide a nutritious food source for woodpeckers that congregate in the burned area. The colonized wood will begin to decompose quickly through the action of decay fungi brought in by the woodborers. In the medium to long term, these insects will be replaced by others such as carpenter ants that utilize wood in a more advanced state of decay. In general, the significance of these wood-boring insects will be confined to *recently* dead wood and will decrease as time goes on.

The bark beetles in ponderosa pine, sugar pine and Douglas-fir could be important as tree mortality agents in the short to mid term, causing the death at first of trees severely damaged by the fire and then subsequently infesting trees less severely damaged. Within three to four years small infestations may develop in stands outside the perimeter of the Davis Fire if weather conditions favor the buildup of these insect populations within the fire-damaged trees. Larger trees in surrounding stands may be infested and killed if bark beetle populations reach epidemic (outbreak) levels. In the long term, populations will revert to endemic levels until the next disturbance event generates more habitat for them.

Cumulative Effects

Within Central Oregon, other wildfires have occurred recently (e.g. 18 Fire and B & B Fire). Although many insects have dispersal capabilities of several miles, there will likely be no influence from those other fires on the area around the Davis fire. Bark beetles come from at least three miles away to colonize trees damaged in the fire, and their broods may fly out that far next year or in coming years, so although there is a perimeter effect, it is of a local nature.

Fire and Fuels

Key Issue: Passive Recovery in Late Successional Reserve vs. Recovery using Active Management, Including Commercial Salvage

Passive Management in the Late Successional Reserve vs. Recovery Using Active Management, Including Commercial Salvage: Active management in the post-fire landscape is opposed by some people. Some public comments show a desire to "natural" post-fire recovery and passive processes, and alternatives were suggested to restore the area through non-commercial means. Public input on the best approach to recovery demonstrates the divergent points of view on what approach to recovery would best accomplish the purpose and need. The essential indicator for this issue is the recovery of late and old-structured stands over time.

Attributes and Measures: Expected influence of fire behavior in the project area: fire behavior, size, and intensity.

Introduction

This report provides information and analysis for fire and fuels resource condition of the Davis Fire Recovery Project area. Direction for managing fire and fuels may be found in:

- Forest Plan Final EIS, Chapter 3
- The Deschutes National Forest Land and Resource Management Plan, Chapter 4 and Appendix I.
- Northwest Forest Plan
- Davis Late-Successional Reserve Assessment
- Odell Watershed Analysis
- Regional Forester's Plan Amendment (Eastside Screens)
- Inland Native Fish Strategy (INFISH)

The National Fire Plan provides national direction for hazardous fuel reduction, restoration, rehabilitation, monitoring, applied research and technology transfer. In August 2000 President Clinton asked the Secretaries of Interior and Agriculture to recommend how best to respond to the recent fire events, reduce the impacts of wildland fires on rural communities, and ensure sufficient firefighting resources in the future. The President also asked what actions federal agencies, in cooperation with states and local communities, could take to reduce immediate hazards to communities in the wildland/urban interface, and to ensure that fire management planning and firefighting personnel and resources are prepared for extreme wildland fires in the future (USDA 2000, p. 1).

The Forest Service responded in October 2000, with the report "Managing Impacts of Wildfires on Communities and Environment" (USDA 2000), known as the "National Fire Plan". In the report, the Chief of the Forest Service outlined operating principles including: firefighting readiness, prevention through education, rehabilitation, hazardous fuel reduction, restoration, collaborative stewardship, monitoring, jobs, and applied research and technology transfer. The Davis Fire Recovery Project responds to the rehabilitation, hazardous fuel reduction, and restoration elements of the National Fire Plan.

- Rehabilitation – Focus rehabilitation efforts on restoring watershed function, including protection of soil and water resources, biological communities, and prevention of invasive weeds.

- Hazardous Fuels Reduction – Assign highest priority for hazardous fuels reduction to: communities at risk, readily accessible municipal watersheds, threatened and endangered species habitat, and other important local features where conditions favor uncharacteristically intense fires.

- Restoration – Restore healthy, diverse, and resilient ecological systems to minimize uncharacteristically intense fires on a priority watershed basis. Methods will include removal of excess vegetation and dead fuels through thinning, prescribed fire, and other treatments.

Affected Environment

Ecological Role of Fire as a Disturbance Process

In April 2002, a national course-scale assessment was completed that quantifies land condition in the coterminous United States. The analysis describes the degree of fire regime departure from historic fire cycles due to fire exclusion and other influences (Schmidt et al 2002).

This course scale analysis identifies changes to key ecosystem components such as species composition, structural stage, tree or shrub stand age, and canopy closure. It characterizes the landscape by five "Fire Regime Groups" and three "Fire Condition Classes" (USDA/USDI 2002).

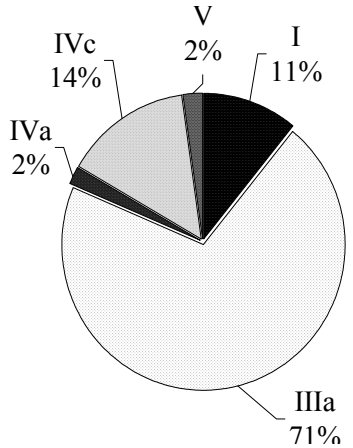
A fire regime is a generalized description of fire's role within an ecosystem – characterized by fire frequency, predictability, seasonality, intensity, duration and scale (USDA/USDI 2002). Fire condition class is a landscape-level attribute which characterizes the degree of departure of vegetation composition and structure, and fire frequency and severity that currently exist inside the fire regime.

The national fire regime scheme has been modified for use within the Central Oregon Area (Central Oregon Fire Management Plan, USFS 2003e). For Davis Fire Area, fire regimes are identified by plant association group (PAG), as shown in the table below.

Table 3.42 Fire Regimes

Fire Regime Group	Fire Frequency	Fire Severity	Plant Association Group
I	0 – 35 years	Low	Ponderosa Pine
II	0 – 35 years	Stand Replacement	Non-forest grass
IIIa	< 50 years	Low/Mixed	Mixed Conifer Dry
IVa	35 – 100 years	Stand Replacement	Lodgepole Wet
IVc	100 – 200 years	Stand Replacement	Lodgepole Dry
V	200 – 400 years	Stand Replacement	Western Hemlock Dry

Figure 3.16 Fire Regime Group Composition for Davis Fire Area



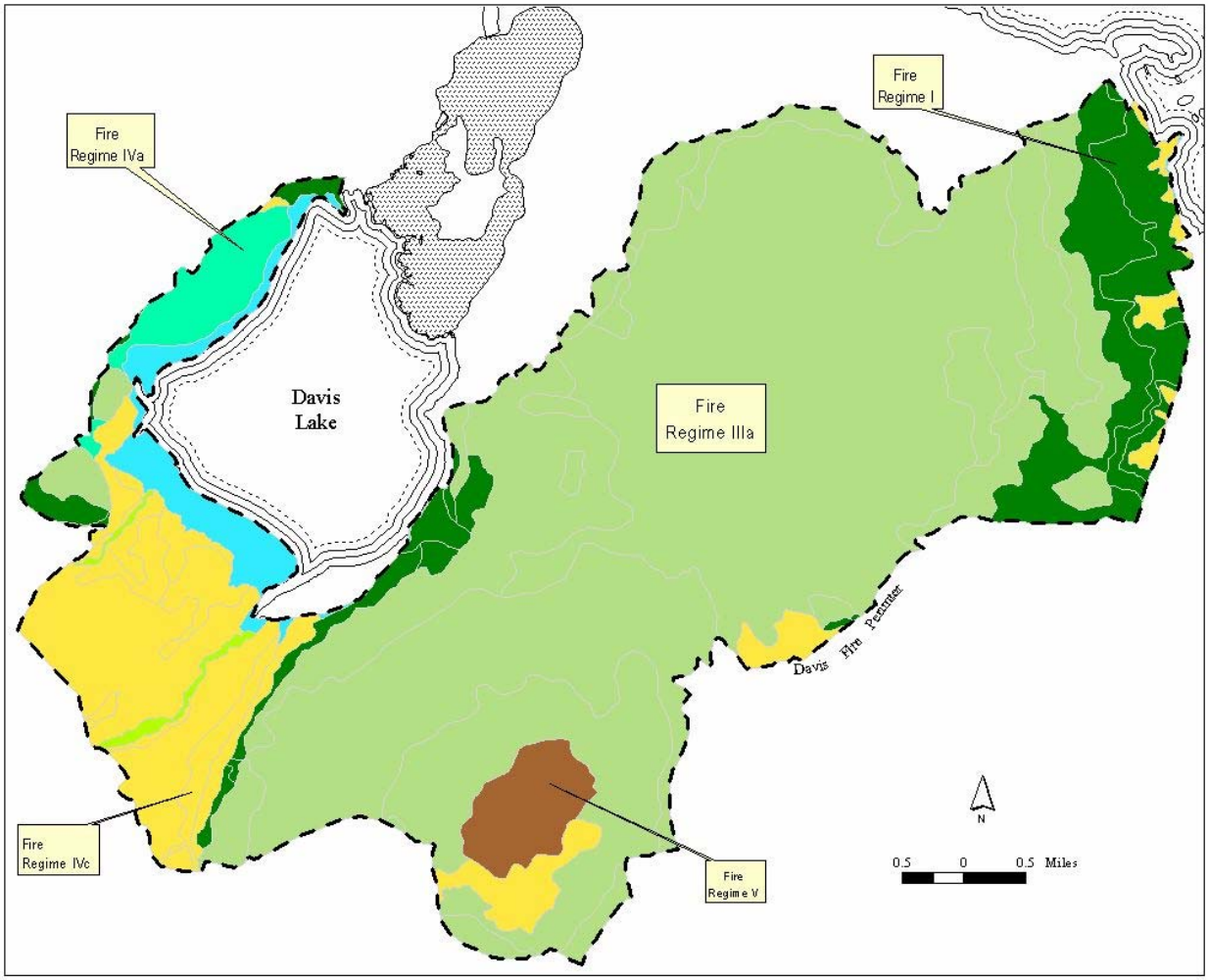
Condition Class Descriptions

Condition classes are a function of the degree of departure from historic fire regimes resulting in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure. One or more of the following activities may have caused this departure: fire exclusion, timber harvesting, grazing, introduction and establishment of exotic plant species, insects or disease (introduced or native), or other past management activities.

Table 3.43 Condition Classes within the Davis Fire Recovery Project Area

Condition Class	Attributes	Example Management Options
Condition Class 1	▪ Fire regimes are within or near an historical range. ▪ The risk of losing key ecosystem components is low. ▪ Fire frequencies have departed from historical frequencies (either increased or decreased) by no more than one return interval. ▪ Vegetation attributes (species composition and structure) are intact and functioning within an historical range.	Where appropriate, these areas can be maintained within the historical fire regime by treatments such as fire use.
Condition Class 2	▪ Fire regimes have been moderately altered from their historical range. ▪ The risk of losing key ecosystem components has increased to moderate. ▪ Fire frequencies have departed (either increased or decreased) from historical frequencies by more than one return interval. This change results in moderate changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns. ▪ Vegetation attributes have been moderately altered from their historic ranges.	Where appropriate, these areas may need moderate levels of restoration treatments, such as fire use and hand or mechanical treatments, to be restored to the historical fire regime.
Condition Class 3	▪ Fire regimes have been significantly altered from their historical range. ▪ The risk of losing key ecosystem components is high. ▪ Fire frequencies have departed (either increased or decreased) by multiple return intervals. This change results in dramatic changes to one or more of the following: fire size, frequency, intensity, severity, or landscape patterns. ▪ Vegetation attributes have been significantly altered from their historic ranges.	Where appropriate, these areas need high levels of restoration treatments, such as hand or mechanical treatments. These treatments may be necessary before fire is used to restore the historical fire regime.

The majority of the Davis Fire Area (71%) is within Fire Regime IIIa (Mixed Conifer Dry PAG). About 11% of the area is in Dry and Wet Ponderosa Pine PAGs, these are combined into Fire Regime I. Fire Regime IVc is represented by the Lodgepole Dry PAG and makes up 14% of the area. Minor amounts (2% each) of Fire Regimes IVa and V are present.



Map #17. Fire Regimes, Davis Fire Area

The Davis Fire did not change Fire Regime composition. However, changes did occur to condition class based on fire severity. Condition Class can be determined by comparing the degree of departure from historic natural conditions for each Fire Regime within the Davis Fire Area. Components in the assessment include: vegetation condition and fire frequency and severity.

Vegetation Condition

Fire Regime I: Effects of the Davis Fire resulted in loss of much of the tree dominated area. Currently approximately 42% of area within this fire regime is dominated by early successional grass, forb, shrub and seedling sapling stages, the HRV for these stages is 0 - 20%. There is a deficiency in the large-size single strata ponderosa pine stage, there is 0% of this stage, and the HRV is 20 – 50%. Departure from reference conditions is estimated to be in between 33 and 67%.

Fire Regime IIIa: Currently about 86% of the area within this fire regime is dominated by the grass, forb, shrub stage, the HRV for this stage is 0 - 20%. Departure from historic reference conditions is estimated to be in excess of 67%.

Fire Regime IVa: Effects of the Davis Fire resulted in loss of much of the tree dominated area. This fire regime represents a small portion of the Davis Fire area about 2%. Currently approximately 80% of area within this fire regime is dominated by early successional grass, forb, shrub stage. This fire regime

represents areas that may exhibit a wide variation in structural stages because of the relatively long fire interval and severity (stand replacement). Departure from historic reference conditions is estimated to be less than 33%. Effects of the Davis Fire within this fire regime are within those of a functioning ecosystem.

Fire Regime IVc: Fire Regime IVc makes up about 14% of the Davis Fire area. The fire regime is assigned to the Dry Lodgepole Pine PAG, associated with deep, poorly developed volcanic ash soils, and cold air drainage. High intensity fire resulted in stand replacement effects for a high percentage of this fire regime. Currently approximately 85% of area within this fire regime is dominated by early successional grass, forb, shrub stage. This fire regime represents areas that may exhibit a wide variation in structural stages because of the relatively long fire interval and severity (stand replacement). Departure from historic reference conditions is estimated to be less than 33%. Effects of the Davis Fire within this fire regime are within those of a functioning ecosystem.

Fire Regime V: A minor portion (2%) of the Davis Fire in this fire regime. This fire regime is associated with cooler, wetter sites and assigned to the Dry Mountain Hemlock PAG. Typical fire return interval would be 200 to 400 years. A mixture of fire intensities occurred with the Davis Fire. Approximately 73% of the area in this fire regime has pole and small sized trees remaining. Departure from historic reference conditions is estimated to be less than 33%.

Fire Frequency and Severity

Pre-Fire Condition

Fire Regime I: The Deschutes National Forest maintains a historic large fire record dating back to about 1905. An analysis of this record indicates that up the occurrence of the Davis Fire about 700 - 800 acres had burned within the Davis Fire area. The majority of this burned in 1 fire (South Davis Lake Fire) in 1910. Approximately 50 acres burned within the area classed as Fire Regime I. The historic reference fire frequency ranges from about 5 to 35 years. This short-interval fire cycle would indicate that most of the Fire Regime I area would have experienced 3 or more fire events during the last 100 years. Prior to the Davis Fire frequency of fire disturbance had departed substantially from reference conditions.

Fire Regime IIIa: Very little of this fire regime had experienced a fire prior to the Davis Fire, for the 100 years of record. The historic reference fire frequency ranges from 35 to 100 years. It is likely that within the Davis Fire area most of the area in these Fire Regimes had missed at least 1 fire cycle.

Fire Regime IVa: No large fires are shown to have occurred within this fire regime prior to the Davis Fire. This period of no fires is within the historic fire return interval.

Fire Regime IVc: One large fire occurred within this fire regime (South Davis Lake Fire) in 1910, size was about 700 acres. Occurrence of this fire and the period of little large fire activity up to the occurrence of the Davis Fire is within the historic fire return interval.

Fire Regime V: No large fires are shown to have occurred within this fire regime prior to the Davis Fire. This period of no fires is within the historic fire return interval.

The historic record contains no data on the severity of past large fires. Historically fires occurring with Fire Regime I were low intensity and had little effect on the dominant vegetation layer. Large-stand replacing fire could occur within Fire Regime I under extreme weather conditions, but were very rare events associated with exceptional droughts.

Fire within Fire Regime IIIa historically were of mixed intensity and had variable effects to the dominant vegetation. Large, stand replacing fires could occur but were very rare. Fire disturbance resulted in a mix of stand ages and size classes. Historic fire severity within Fire Regime IIIa would tend to low intensity supporting and maintaining a higher percentage of early seral ponderosa pine.

Historic fire severity within Fire Regimes IVa, IVc, and V was stand replacement. High intensity fire with severe effects on the dominant vegetation layer would be expected under historic conditions.

Post-Fire Condition

The scale and intensity of the Davis Fire were uncharacteristic compared to reference conditions within Fire Regimes I and IIIa. Burn intensity for the Davis Fire within Fire Regime I was uncharacteristic with about 40% of the area affected as stand replacement, and 80% stand replacement within Fire Regime IIIa. The fire intensity expected within Fire Regimes I and IIIa under historical conditions would be low with a small percentage of moderate.

The table below summarizes the elements of vegetation condition, fire frequency and severity in the determination of condition class for the Davis Fire Area.

Table 3.44 Estimated Percent Departure from Historic Reference Conditions and Condition Class

Fire Regime	Vegetation Condition Departure from Reference Conditions	Fire Frequency	Fire Intensity	Condition Class
I	40	70	40	2
IIIa	70	50	70	3
IVa	20	0	0	1
IVc	10	0	0	1
V	20	0	0	1

Fire Regime IIIa which makes up the majority of the Davis Fire area is characterized as Condition Class 3, because of substantial departure from reference conditions for vegetation, fire frequency and intensity. Fire Regime I is characterized as being in Condition Class 2 because of a moderate amount of departure from reference conditions. Fire Regimes IVa, IVc, and V are shown as Condition Class 1 and essentially functioning with the ranges of historic reference conditions.

Fuel Loading and Arrangement

Fuel levels and risk of damage from wildfires is a component of the purpose and need for the Davis Fire Recovery Project. Components are described below.

- Bringing fuel load levels and fuel arrangement to conditions that reduce the likelihood of stand-replacement fire in regenerated stands, particularly during the early stages of stand development, will promote the long-term survival and growth of new conifers.

  Fuel load and arrangement will be described for the Davis Fire Area. Fuel conditions resulting from the alternatives will have associated effects on fire behavior including potential fire intensity. The effect a fire may have on resources depends on fire intensity and the conditions of the environment, including vegetation, in which it burns.

- Adjusting the fuel conditions within Ponderosa pine stands, particularly within the Bald Eagle Management areas, to levels supporting the future use of prescribed fire. Salvage and fuel treatment in these stands would result in fuel characteristics reflective of Condition Class 1, where prescribed fire could be used for maintenance and the likelihood of damage to large Ponderosa pine from wildfire would be reduced.

  Estimates of fire behavior under prescribed fire conditions are described. Low intensity prescribed fire applied within ponderosa pine stands would maintain stand density, species composition and structure to meet habitat requirements for the bald eagle and reflect the historic fire disturbance regime.

- Fuel loading within the Davis Late Successional Reserve (LSR) is likely to reach levels that would potentially damage soil productivity, residual live trees and snags in the event of a reburn.

  The Northwest Forest Plan provides direction to enhance and protect late and old structure within Late Successional Reserves. Over time the existing dead trees will fall and become down wood accumulating as surface fuels with the potential to increase fire intensity. It is recognized that down wood is an essential component of ecosystems within the Davis Fire area, particularly within LSR, providing wildlife habitat, soil protection and other important functions. Alternative down wood levels that provide essential function and levels which represent a potential for adverse impacts to soil productivity and other ecosystem components is analyzed.

- Fire risk is elevated in areas of human development and along major roads. There is a need to protect the surrounding forest from risk of fire spreading from the developed campgrounds and from Highway 46.

  Concentrations of human activity have increased the occurrence of fires along high traffic areas and campgrounds within and adjacent to the Davis Fire area. Fuels treatment is proposed to reduce fuel loading and remove ladder fuels within these areas. Fire behavior potential is described for the alternatives.

Existing Conditions

Fuel Loading

One objective in burned areas is to reduce fuels so that they more closely approximate historic dead and down woody fuel loads. At lower and middle elevations, this is an important ecological concept because fuel loads can significantly contribute to the effects of a fire disturbance but often exist in levels above pre-European settlement (Brown 2000 p. 14; Everett et al 2000 p. 220). It is generally accepted that fire suppression and past large-tree harvesting operations have contributed to excess tree densities and fuel loads in ecosystems that developed with relatively short fire intervals (Brown 2000 p. 7).

In many places in the western United States, organic matter is produced at a higher rate than it can be cycled by decay. The accumulation of this woody material may increase the likelihood of severe stand replacing wildfires (DeBano et al 1998, p. 140). "Fuel buildups continue and become more continuous in distribution. As a consequence, subsequent occurrence of high-severity fire results in generally greater changes in plant compositions and structure than would occur if the communities had been subjected to more frequent low-intensity fires" (DeBano et al 1998, p. 201). Uncharacteristically high fuel levels create the potential for fires that are uncharacteristically intense (Franklin and Agee 2003). If lower and mid-elevation ecosystems are to experience a disturbance regime similar to that which they are adapted, the fuels must first be reduced to keep fire effects within an historic range. One goal of this project is to manage future fuel loads and fuel arrangement to be within a manageable range for both fire control and ecosystem processes.

The post-fire conditions and consumption of large wood found at the Davis Fire (as well as other recent fires on the Deschutes National Forest) has shown that large fuels greater than 12 inches are indeed flammable and dry out during the fire season. Large fuels were completely consumed over extensive areas of the fire, contributing to tree mortality and in some instances, severe soil heating.

A down woody fuels inventory was completed within the Davis Fire perimeter following the Davis Fire of 2003. Sample plots were taken in the Mixed Conifer Dry, Ponderosa Pine Dry, Ponderosa Wet and Lodgepole Pine Dry plant association groups that burned with high, moderate, or mixed intensities. Activity history describes pre-fire harvest activities or fuels treatments. *Standing dead or aerial fuels are not included in this summary.*

Table 3.45 Summary of Fuels Inventory Listed by Stands Samples

Sample Number	PAG	Burn Intensity	Fuel Load <3" diameter tons/acre	Fuel Load >3" diameter tons/acre	Total Fuel Load tons/acre	Activity History
MCD1	MCD	High	2.46	9.68	12.14	Underburn, date unknown
MCD2	MCD	Mixed	1.87	15.61	17.48	Final Removal Harvest 1988, machine pile & burn 1989
MCD3	MCD	Mixed	1.4	16.9	18.3	Overstory Removal Harvest 1988, machine pile & burn 1989
MCD4	MCD	Mixed	1.9	15.91	17.81	Underburn, date unknown
MCD5	MCD	High	.71	6.93	7.65	Precommercial Thin 2000, Hand Pile & burn 2003
MCD6	MCD	High	2.21	11.1	13.31	Underburn, date unknown
LPD1	LPD	Mixed	1.57	19.32	20.90	No Activities
LPD2	LPD	High	0.98	12.53	13.51	No Activities
LPD3	LPD	Moderate	1.59	21.5	23.09	No Activities
LPD4	LPD	High	0.89	6.21	7.1	Salvage 1991, Hand Pile & Burn 1994
LPD5	LPD	High	2.06	6.27	8.33	Selection Harvest 2001
LPD6	LPD	Moderate	2.21	15.95	18.17	No Activities
PPD1	PPD	High	1	4.19	5.19	No Activity
PPD2	PPD	Mixed	1.81	7.85	9.67	No Activity
PPD2A	PPD	High	0.39	4.08	4.47	No Activity
PPD3	PPD	Moderate	2.43	21.8	24.23	Harvest Thin 1998, PCT 2003
PPD4	PPD	High	1.89	16.48	18.37	Harvest Selection 1998, 2002, PCT 2003
PPD5	PPD	Moderate	1.46	14.62	16.08	No Activity
PPW1	PPW	Moderate	1.38	6.34	7.72	Underburn, date unknown
PPW2	PPW	High	1.42	3.45	4.87	Underburn, date unknown
PPW3	PPW	High	1.47	5.78	7.25	Underburn, date unknown
PPW4	PPW	Moderate	3.05	9.64	12.69	Underburn, Date unknown
PPW5	PPW	High	.79	6.97	7.76	No Activities
PPW6	PPW	Moderate	1.66	10.61	12.28	Clearcut 1979, Machine Pile & Burn 1981

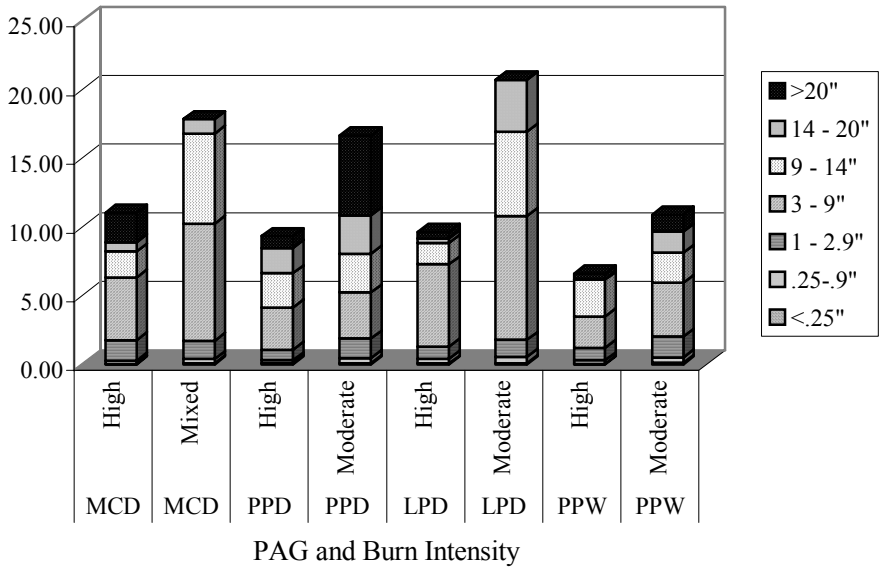


Figure 3.17 Down Fuel Loading in Tons per Acre by PAG, Burn Intensity, and Size Class

Results of the fuels inventory are not unexpected. Areas experiencing high burn intensity in all PAGs have a lower ground fuel loading that those areas where the Davis Fire burned at moderate or mixed severity.

Discussion of Factors Used to Describe Effects of the Alternatives

Fire Behavior

Fire Behavior is the manner in which fire reacts to topography, weather, and fuels (DeBano et al 1998 p. 11; NWCG,1998 p. G-7). These three elements comprise the fire environment, the surrounding conditions, influences, and modifying forces that determine fire behavior (NWCG, 1994 p. 8).

Modifying any one of these elements has a direct result on fire behavior, which is basically described by flame length and rate of spread. Favorable conditions for crown fires include heavy accumulations of dead and downed litter, conifer reproduction and other ladder fuels, and continuous conifer tree forest (Rothermel 1991 p.2).

The greater the fuel loading, the more intensely a fire is likely to burn (DeBano et al 1998 p.57) Conversely, a reduction in fuel loading can limit the fires intensity. Fuel characteristics affecting fire behavior are vegetative density, species composition, amount of surface fuel, arrangement of fuels and moisture content (Rothermel 1983 p.9). Fuels contribute to the rate of spread of a fire, the intensity/flame length of the fire, how long a fire is held over in an area, and the size of the burned area (Rothermel 1983 p.59).

Treatments that reduce surface fuel loads have been shown to decrease fire behavior and severity (Graham et al 1999 p.18, 20) (Pollet and Omi, 1999, p. 3). Van Wagtendonk (1996) found in fire simulations that a reduction in fuel loads decreased subsequent fire behavior, increased fire line control possibilities and decreased fire suppression costs. Fire line construction rates increase with decreased fuel loads, decreased fuel loads means a lower resistance to control.

Intensive forest management that involves the creation of activity fuels (slash) can indeed increase fire behavior parameters such as rate of spread and flame length. However, treatment of slash (e.g. burning, chipping, removal, isolation) will reduce fire behavior and fire intensity (Omi and Martinson, 2002). Graham et al (1999

p.22) reports that thinning from below and intermediate tree harvest can effectively alter fire behavior by reducing crown bulk density and ladder fuels, but will not reduce crown fire potential unless tree densities are substantially reduced. Graham et al (1999 p.20) also states that all intermediate treatments should be accompanied by surface fuel modification, and the most success is achieved when using prescribed fire for such treatments.

There are three types of fuels that affect fire behavior; fine fuels such as grass or forbs, small woody fuels less than three inches in diameter and large woody fuels greater than three inches in diameter Fine fuels are the major contributors to fire spread, carrying the ignition and flaming front of a fire (Rothermel 1983 p.1). Without these fine fuels, many fires will not get large, although there are exceptions. However, eliminating fine fuels (litter, duff, grasses) is neither possible nor desirable. Small woody fuels influence a fire's rate of spread and fire intensity, and small woody fuels lose their moisture faster, start easier and burn more readily (Agee 1993).

Under a frequent fire regime it will be possible to maintain fine fuels at lower levels and various patch sizes than under a less frequent fire regime, but fine fuels will always exist. Aside from eliminating the fine fuels that contribute to fire spread, only the total amount and arrangement can be modified to benefit fire control efforts. From a firefighter's perspective, it is better to construct fire line through 2" of this small material to reach mineral soil (therefore stopping fire spread) than to dig through 10" of fine fuels because the fire line construction will progress faster and the fire could potentially be contained at a smaller size.

Large fuels (greater than 3" diameter) do not contribute greatly to fire spread, and are not considered in the BEHAVE fire spread prediction model, though they do remain burning after the fire front has passed (Andrews 1986 p.9) and contribute to fire severity. Due to large dead and down woody fuel contributions to fire behavior and control, reducing the amount of large, dead and down woody debris will increase the potential for using prescribed fire, in turn; help keep the fine fuel load at a relatively low level.

There are several expressions of fire intensity. Radiant intensity is the rate of thermal radiation emission. Convective intensity is that part of the total heat output from a fire that lifts gases and entrains air above the flame zone. Total fire intensity, the rate of heat output of the fire as a whole, is the function of the rate of area burned, fuel loading, and estimated heat yield. Reaction intensity, the total heat release per unit area of fuel bed divided by the burning time, is the time-averaged rate of heat release of the active fire front. Fireline intensity, also called Byram's intensity, is the product of the available heat of combustion per unit area of ground surface and the rate of spread of the fire. The equation is (from DeBano et al 1998 p. 57):

$I = .007HWR$, where

I = intensity (kW/m)

H = Heat yield (cal/g)

W = fuel loading (Mg/ha)

R = rate of spread (m/min)

Fire line intensity was also described by Rothermel in 1991 as:

$I = Rwh$, where

I = intensity (Btu/ft/s)

R = rate of spread (ft/s)

W = available fuel (lb/sq ft)

H = heat of combustion (Btu/lb)

Based on these established relationships it follows that if available fuel is reduced, there is a reduction in fire line intensity. Fireline intensity has been related empirically to flame length, which is easily measured in the field (DeBano et al 1998 pp. 56 – 57).

Fire Hazard

Fire hazard generally refers to the difficulty of controlling potential wildfire. It is commonly determined by fire behavior characteristics such as rate of spread, intensity, torching, crowning, spotting, and fire persistence and by resistance to control. Fire severity, referring to the effects of fire on the ecosystem, may also be considered to be an element of fire hazard (Brown et al, 2003, p. 4).

Downward heat transfer into the soil is an important determinant of fire severity (Ryan and Noste 1985). Fire intensity, largely a measure of upward heat transfer, is not a reliable indicator of fire severity because it correlates poorly with downward heat transfer (Brown et al, 2003).

Resistance to Control

Resistance to control is generally viewed as an estimate of the suppression force required for controlling a unit of fire perimeter. The USDA Forest Service Pacific Southwest Region (1976) developed a resistance to control rating scheme based on difficulty of handline construction and an inventory of downed woody fuel loadings by size classes. High and extreme resistance to control ratings were reached for the following loadings in tons per acre:

Table 3.46 High and Extreme Resistance to Control Ratings Based on Loadings in Tons per Acre

0 – 3 inch diameter	3 – 10 inch diameter	
	High	Extreme
5	25	40
10	15	25
15	5	15

The above ratings were based on the assumption that few downed pieces greater than 10-inch diameter were present. In computing the ratings, the number of large pieces (greater than 10 inches) by length class is more important than their loading in determining resistance to control. If the number of pieces greater than a 10-inch diameter exceeded 10 to 20 per acre, depending on length, less 3 – 10 inch diameter material would be required to reach the high and extreme resistance to control ratings (Brown et al, 2003).

Fire Occurrence

Based on historic records the Davis Fire area has a moderate fire occurrence rate, with 235 fires recorded during the period from 1940 through 1995. Fire cause was 61 percent lightning and 39 percent human caused. This pattern will likely remain constant into the future (USFS 1995).

Restoring Fire as a Disturbance Process

One objective in burned areas is to reduce fuels so that they more closely approximate historic dead and down woody fuel loads. At lower and middle elevations, this is an important ecological concept because fuel loads can significantly contribute to the effects of a fire disturbance but often exist in levels above pre-European settlement (Brown, R. 2000 p.14; Everett, et al 2000 p. 220). It is generally accepted that fire suppression and past large-tree harvesting operations have contributed to excess tree densities and fuel loads in ecosystems that developed with relatively short fire intervals (Brown, R. 2000 p.7).

In many places in the western United States organic matter is produced at a higher rate than it can be cycled by decay. The accumulation of this woody material may increase the likelihood of severe stand replacing wildfires (DeBano et al. 1998 p. 140). “Fuel buildups continue and become more continuous in distribution. As a consequence, subsequent occurrence of high-severity fire results in generally greater changes in plant compositions and structure than would occur if the communities had been subjected to more frequent low-

intensity fires"(DeBano et al. 1998 p. 201). If lower and mid-elevation ecosystems are to experience a disturbance regime similar to that which they are adapted, the fuels must first be reduced to keep fire effects within an historic range. One goal of this project is to manage future fuel loads and fuel continuity to within a manageable range for both fire control and ecosystem processes. Treatments which reduce surface fuels, increase canopy base height, decrease crown density, and increase the proportion of fire-resistant trees (example ponderosa pine) contribute to the fire-resiliency of forest stands (Graham et al, 2004).

Within the Davis Fire area Fire Regimes I and III would be areas on which to focus for restoring fire's role as a disturbance process. The occurrence of the Davis Fire presents an opportunity to examine the affected area and identify areas and treatments that would help create conditions favorable for the re-introduction of fire, primarily prescribed fire, as a disturbance process into the area.

Fire Regime I: Fire regime I includes Dry and Wet Ponderosa Pine plant association groups (PAGs). In ponderosa pine forests, it has taken several decades of fire suppression to create the conditions existing which existed prior to the Davis Fire, and one treatment is not going to immediately return this forest to a condition to which it would function under the historical low-severity fire regime (Brown, R. 2000 p.13). The goal, then, is not to completely return these forests to a historic fuel load with one treatment, but to prescribe treatments that would start to move them toward a historic level, which would allow a more natural fire regime to function.

Ponderosa pine forests have undergone substantial structural changes since earlier this century due to fire suppression and logging. Heavy fuel loads and ladder fuels make these stands more susceptible to large, uncharacteristic crown fires. This may result in an increased risk of fire intensity and severity that could exceed the lethal limits of thick barked species (USDA, 2000 p.13; USDA, 2001 p.2). "Certain forest types (low elevation ponderosa pine, for example) may be susceptible to burning in ways that have not been seen in centuries" (Beschta et al 1995 p.5). The type of fire behavior that can be exhibited by this changed stand condition can make conditions less safe for firefighting operations.

To move forests towards a more natural fuel condition, fire will be managed, through the use of prescribed fires. Actions proposed in the alternatives are aimed at reducing fuel loading now so that as conifer stands develop the option of using prescribed fire will be available to either maintain or enhance desired conditions. A reduced fuel load would increase the variance of weather and fuel conditions under which prescribed fire could be applied.

Hall (2003) suggests that the historical condition contained very little woody fuel averaging about 3 to 6 tons/acre. The optimum range of Coarse Woody Debris (CWD) for warm dry forest types is described as 5 to 20 tons per acre (Brown, 2003). After the Davis Fire, projected fuel loads show the surface fuel loads on most PP sites exceeding 40 tons/acre, after 25 years, estimations and models predict that fuel loads could exceed 60 tons/acre on some sites.

Fire Regime III: Fire Regime III includes the mixed conifer wet and mixed conifer dry PAGs. Agee (1992) believes that historically the mixed conifer forests show the most frequent fire activity of all Eastside forests, although cooler, wetter sites (mixed conifer wet) would tend to have longer fire return intervals. Frequent fire intervals in drier plant associations are likely due to higher productivity, when compared to Ponderosa pine associations. After a fire, the fine dead fuels needed to carry another fire are rapidly replaced in the mixed conifer associations.

The optimum range of Coarse Woody Debris (CWD) for cooler mesic types is described as 10 to 30 tons per acre (Brown 2003). After the Davis Fire, projected fuel loads show the surface fuel loads on most mixed conifer sites exceeding 60 tons/acre. After 25 years, estimations and models predict that fuel loads could exceed 70 tons/acre on some sites.

To introduce prescribed fire as a disturbance on the Davis Fire area, it is necessary to first remove some of the fuels to allow for these fires to be safe and ecologically beneficial. From a firefighting perspective, less fuel is better, however, it is not ecologically appropriate to reduce fuel levels below that which provides for other ecosystem functions and such reductions are not proposed in this project.

Discussion of Activities Proposed

Fuel Treatments within Ground-based Units

Salvage logging would be done with either yarding with top attached to top log or whole tree yarding. In some units unmerchantable dead trees from 3 inches to 12 inches dbh would be felled. Unmerchantable tree felling is proposed to hasten the fall and decay process of this material, and to make the material available to the grapple piling operation. Unmerchantable tree felling would be done over an estimated 40 to 60% of the unit area. Some areas within units may not have an abundance of this sized material, and some areas within units would be left untreated to maintain a diversity of conditions.

Grapple piling is prescribed for most ground-based harvest units. Grapple piling machines would be confined to existing skid trails, so that soil effects are confined to that already used in the salvage harvest operation. The amount of area unreachable by grapple depends on the skid trail spacing but it is estimated that 30 to 40 percent of each unit would not be reachable. No fuels treatment is proposed within five units: 115, 155, 160, 167, and 320 (a total of about 607 acres).

Fuel Treatments within Skyline and Helicopter Units

Salvage logging would be done with either yarding with top attached to top log or whole tree yarding. In some units unmerchantable dead trees from 3 inches to 12 inches dbh would be felled. Unmerchantable tree felling is proposed to hasten the fall and decay process of this material, and to make the material available to the prescribed fire operation (burn concentrations).

Unmerchantable tree felling would be done over an estimated 40 to 60% of the unit area. Some areas within units may not have an abundance of this sized material, and some areas within units would be left untreated to maintain a diversity of conditions.

Following the salvage harvest and unmerchantable tree felling prescribed fire is planned for these units. Prescribed fire would focus on reducing concentrations of dead and down material, known as jackpot burning. It is anticipated that prescribed fire would be applied to about 60% of each unit.

Fuels Treatments Outside Salvage Units

Fuels treatment is proposed for several areas that are not proposed for salvage activities. The purpose of these treatments is to alter fuels conditions to reduce surface fuels loading and to increase the height to base of live crowns or vertical continuity of fuels. Treatments are proposed for areas that burned at low intensity where there is a substantial residual live tree component. Treatments are proposed to reduce the likelihood of damage in these stands should a fire occur again.

Treatments would include felling understory live trees up to 12 inches in diameter (in spotted owl NRF habitat, trees up to 8” would be felled). Felled material along with existing surface fuel would then be either grapple piled or hand piled, and then burned. Some material may be skidded or decked to provide for utilization either by the public as firewood or commercially as wood chips or hog fuel.

Environmental Consequences

General Description of Vegetative Succession and Fuels Conditions

Alternative A - No Action

Vegetative succession following forest fire including reburn depends on a number of interacting factors including fire severity, prefire vegetation, species adaptations to fire, environmental conditions and chance.

The following description of likely vegetative succession and fuels condition development over time is patterned after Brown et al, 2003, p. 9. Additional site specifics are described for the Davis Fire area based on existing literature and observation of the Davis Fire area.

0 to 10 Years After Davis Fire (2003 – 2013)

During this period small diameter standing dead trees, those less than 3 inches dbh, will fall to the ground, while larger dead trees remain. Natural conifer regeneration would be sparse if any and likely would be dominated by lodgepole pine.

Native forbs and grasses would begin to re-occupy the site. Notable among shrub species would be snowbrush (Ceanothus velutinus), which will likely become re-established quickly, resprouting from existing burned plants and from dormant heat scarified seed in the soil. Another shrub likely to be present is greenleaf manzanita (Arctostaphylos patula). Bitterbrush (Purshia tridentate) may be present but uncommon above 5,000 feet elevation.

Surface fuels for most of this period would not support fire spread sufficiently to pose a threat of any damage. Depending on distribution shrubs and grasses may have become sufficiently established over patches of an acre or less to present a horizontally continuous fuel bed of fine fuels to support the spread of small fires of an acre or so in size. Potential for reburn is low during this period of time (Beschta et al, 1995).

Fuel model 2 or 5 would characterize the fuel condition. Fire intensity would be low to moderate with flame lengths of 2 – 4 feet resulting under most weather conditions. Wildfire would be a surface fire with no potential for crowning, and spotting would be minimal. Potential for suppression forces to control this type of wildfire would be high.

10 to 30 Years After Davis Fire (2013 – 2043)

Most stands will have experienced rapid increases in surface fuel loading as a high percentage of the standing dead trees fall. Surface fuels loading would increase in most stands to a total of 40 to 70 tons per acre. The graph below displays the likely surface fuel loading development over time for several representative stands.

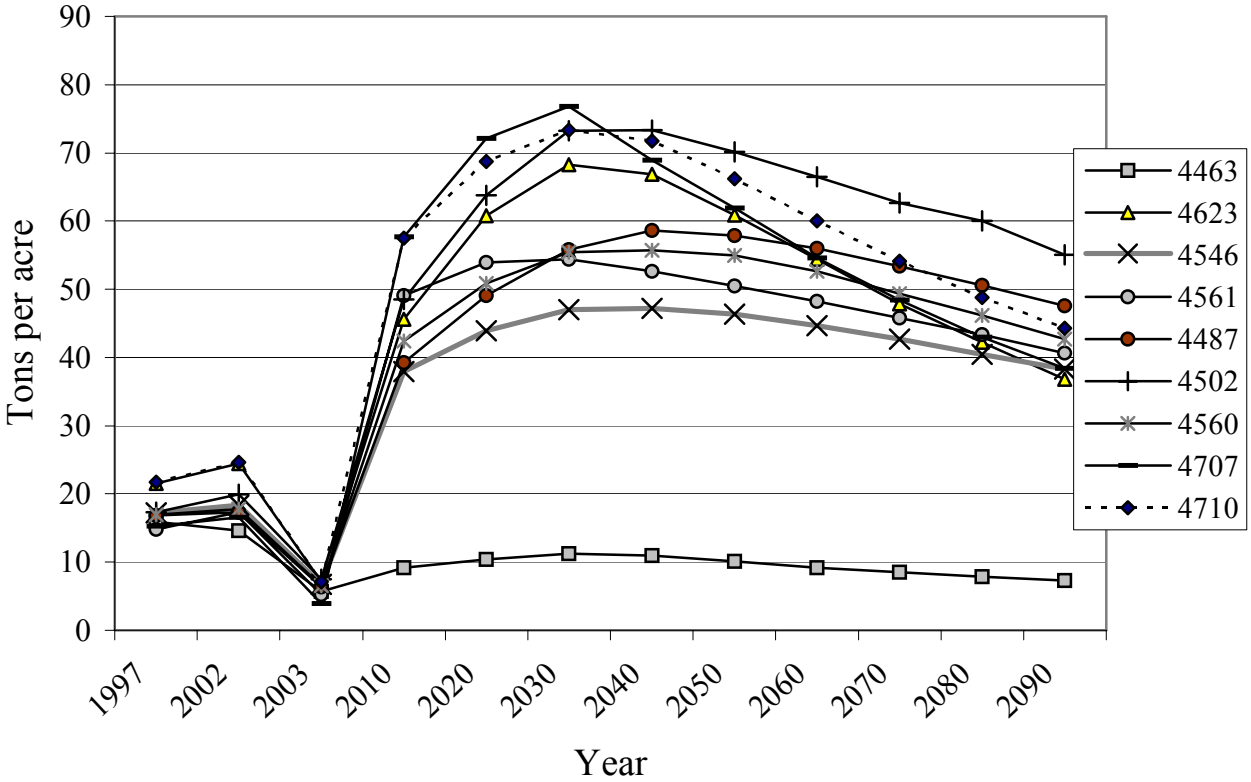


Figure 3.18 Projected Total Fuel Loading with no Treatment for Selected Plots

The graph demonstrates that most stands will follow the same general trend and reach the maximum amount of surface fuels during the period between years 2030 and 2040. A few stands with low number of trees per acre at the time of the Davis Fire will likely maintain at low level of surface fuels.

Native grasses and shrubs would be well established, with shrub species dominating the understory. Shrub composition would likely be dominated by snowbrush with manzanita well represented especially on south facing slopes and areas of shallower soils (Volland 1976). Some conifer regeneration is expected to be evident during this time period. Density of conifer regeneration would be expected to be low probably less than 150 trees per acre and patchy in distribution. Early seral species lodgepole pine and ponderosa pine would be expected.

Downed CWD would exhibit some decay and support a longer burning period. A duff layer would not be well established and would be unable to contribute to soil heating (Brown et al, 2003). High severity fire could be substantial where a large proportion of the soil surface was directly overlain by large woody material (Brown et al, 2003).

Fuel model 6 (shrub) would characterize the fuel condition due to the anticipated dominance of shrubs. A portion of the area would also be characterized as fuel model 12 due to the relatively high level of larger woody fuels. Potential fire behavior increases during this period due to the increased fuel bed depth, fuel loading and arrangement. Potential flame lengths would be in excess of 10 feet under severe conditions and 4 to 6 feet under moderate conditions. Wildfires would tend to be surface fires, however potential for tree torching and crowning would be high depending on the density of continuity of naturally regenerated trees. Potential for spotting would be high due to large numbers of snags, and high potential for lofting firebrands into the air. These fuel conditions would present control problems to suppression forces responding to such a fire primarily due to high fire intensity (>4 ft flame lengths), spread rate (high in fuel model 6) and resistance to control due to high levels of down fuel.

Modeling Predictions

To project future trends of Coarse Woody Debris (CWD) the Fire and Fuels Extension (FFE) (Beukema and others 2000) to the Forest Vegetation Simulator (FVS) (Stage 1973) was used to simulate the effects of alternative management strategies on future quantities of CWD and small woody fuels. The FVS simulates tree growth, tree mortality and regeneration, and the impacts of a wide range of silvicultural treatments. The FFE simulates additions to fuel pools from stand dynamics and management activities, and the removal of fuels through decay, mechanical treatments, and prescribed or wildfires. Various types of fuels are represented, including canopy fuels and surface fuels by diameter classes. Fire behavior and fire effects such as fuel consumption, tree mortality and smoke production are modeled. Model outputs include fuel characteristics, stand structure, snag density, and potential fire behavior that provide a basis for comparing proposed stand and fuel treatments.

30 to 60 Years After Davis Fire

Surface fuels during this period would be at moderate to high levels generally exceeding 40 tons per acre. Trend would be downward as indicated in the graph above. Most of the reduction in the amount of CWD would be due to decay, as material less than 3 inches diameter decays relatively quickly while larger material remains.

As conifer trees develop and produce shade shrub species such as snowbrush and manzanita would begin to decrease (Volland 1976). Pre-fire data from forest inventory plots give an indication of the understory plant composition and percent cover under a well-developed forest canopy. The general trend would be toward decreased percent cover as the conifer canopy increases, shrubs would be present but not as dominant as they had been during earlier periods following the fire.

Downed CWD would exhibit considerable decay and support a longer burning period. A duff layer would be establishing to a variable extent depending on overstory conifer development. Burnout of large woody pieces and duff would be assisted by the interaction of these two components (Brown and others 1991).

Total surface fuel loading begins to decrease after 50 to 60 years, primarily due to decomposition. Smaller diameter CWD decays faster than larger pieces and make up a smaller percent of the total amount. The dynamics of movement of biomass through the system is shown below based on projections using FVS and FFE.

Table 3.47 Biomass Projections for Untreated Stands

Year	% of Total Biomass as Surface Fuels <6 inches Diameter (avg %)	% of Total Biomass as Surface Fuels >6 inches Diameter	% of Total Biomass as Surface Fuels	Estimated Total biomass onsite (Range tons per acre)	Comments
2002 (Pre-fire)	11	5	16	90 - 170	Pre-fire conditions reflect the absence of disturbance from fire, dense multi-strata forest conditions dominate the area. Total biomass is relatively high with a small percentage as surface fuels.
2010	18	16	34	75-120	Total biomass has been reduced by the Davis Fire, Salvage and fuels treatment. Average total reduction is about 50-66%. Surface fuels percentage increases as dead material falls. Fuels less than 6 inches diameter are proportionately higher due to faster fall rates.
2045	12	46	58	60-90	This point in time represents the minimum amount of biomass present on burned sites. Reductions due to the fire and decay are high and additions from new growth haven't compensated for the losses. A high percentage of biomass is surface fuels.
2060	10	43	53	62-100	Total biomass is increasing due to new growth of trees, shrubs and other ground vegetation. Large (>6 inches diameter) surface fuels dominate; most of the smaller size material has decayed.
2100	9	25	34	80-120	Large increases in total biomass on site due to new growth off-setting losses due to decay. A high proportion of surface fuels add complexity to fuel and vegetation profile, increasing hazard of damage to vegetation and soils.

Fuel model 6 (shrub) would characterize the fuel condition due to the anticipated dominance of shrubs. A portion of the area would also be characterized as fuel model 12 due to the relatively high level of larger woody fuels. Potential fire behavior increases during this period due to the increased fuel bed depth, fuel loading and arrangement. Potential flame lengths would be in excess of 10 feet under severe conditions and 4 to 6 feet under moderate conditions. Wildfires would tend to be surface fires, however potential for tree torching and crowning would be high depending on the density and continuity of naturally regenerated trees. Potential for spotting would be high due to snags, and high potential for lofting firebrands into the air. These fuel conditions would

present control problems to suppression forces responding to such a fire primarily due to high fire intensity (>4 ft flame lengths), spread rate (high in fuel model 6) and resistance to control due to high levels of down fuel.

Alternatives B, C, D, and E (Areas Treated with Salvage and Fuels Reduction)

There is no universally accepted view on the potential for an area to burn again after a major fire similar to the Davis Fire. Some references cite that the occurrence of a high intensity fire does not increase the potential for a reburn (Beschta, et al 1995), while others (Brown, et al 2003) suggest that site-specific conditions may play a role for an area to burn again after a large intense fire. An assumption could be made that the probability of ignition remains unchanged in the post-fire environment; that is human activity continues as it has historically, because of the Cascade Lakes Highway and recreational attractions of the area, and natural ignitions (lightning) also remain unchanged. This would result in the fire occurrence rate remaining constant and at historic levels for the future. Considering that the potential for a wildfire to ignite remains unchanged, the expected fire behavior and fire effects can be compared by alternative.

Based on the extent of proposed treatments, the alternatives will have varying effects on the fuel loading and arrangement that affect the potential spread rate, intensity, and resistance to control should a wildfire be ignited. Fast moving fires may involve more area before sufficient suppression forces are able to respond and contain the spread. Higher intensity fires and fires burning in heavy fuels may require additional resources or a different type of suppression equipment in order to contain the spread. Recent monitoring has shown a correlation between reburn and an increase in detrimental effects to soil and vegetation in portions of the 2003 Booth and Bear Fire where they reburned through the 1987 Cabot Lake and Brush Creek fires (Shank 2004). Although there were parts of the Cabot Lake and 1996 Jefferson Fire that did not reburn because of lack of ground fuels sufficient to carry the fire, Shank noted an increase in the extent of detrimentally burned soils as a result of subsequent fires in areas that had previously burned.

The trees proposed for commercial removal are not live and have no fire resistance attributes. Standing dead trees (snags) often contribute to increased fire spotting distances, which can increase fire spread and present control problems for future suppression actions.

0 – 10 Years After Davis Fire (2003-2013)

Vegetation succession and fuel development during this period would be similar for all alternatives.

During this period, small diameter standing dead trees, those less than 3 inches dbh, will fall to the ground while larger dead trees remain standing. Natural conifer regeneration would be sparse if any and likely would be dominated by lodgepole pine.

Fuel model 2 or 5 would characterize the fuel condition. Fire intensity would be low to moderate with flame lengths of 2 – 4 feet resulting under most weather conditions. Wildfire would be a surface fire with no potential for crowning, and spotting would be minimal. Potential for suppression forces to control this type of wildfire would be high.

10 to 30 Years After Davis Fire (2013 – 2043)

Units treated with salvage and fuels treatment will have reduced surface fuel loading compared to untreated areas. Surface fuels loading would increase in most stands to a total of 25 to 40 tons per acre. The graph below displays the likely surface fuel loading development over time for several representative stands.

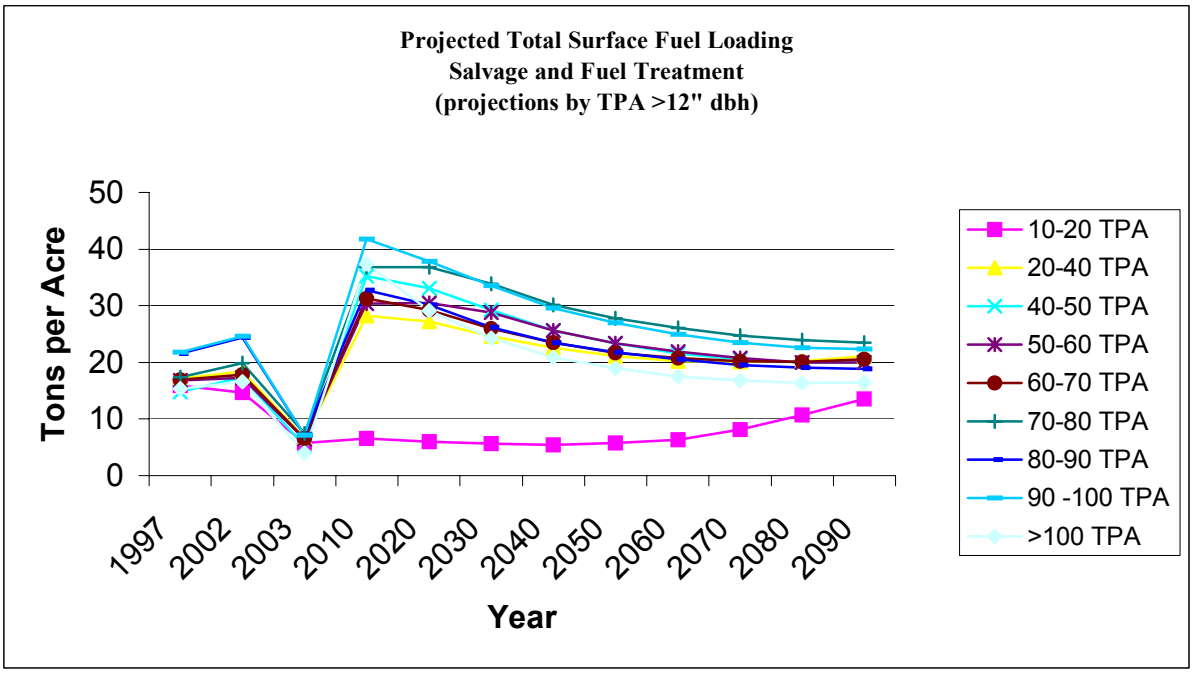


Figure 3.19 Projected Total Surface Fuel Loading, Salvage and Fuel Treatments Alts B, C, D, and E

The graph demonstrates that most treated stands will follow the same general trend and reach the maximum amount of surface fuels during the period between years 2015 and 2030. A few stands with low number of trees per acre at the time of the Davis Fire will likely maintain at low level of surface fuels. With salvage and fuels treatment maximum surface fuel loading is reached earlier than under no treatment.

Native grasses and shrubs would be well established, with shrub species dominating the understory. Shrub composition would likely be dominated by snowbrush with manzanita well represented especially on south facing slopes and areas of shallower soils (Volland 1976).

Density of conifer planted trees would be expected to be 150 to 200 trees per acre. Early seral species dominated by ponderosa pine would be expected. The diameter and height of planted trees is expected to be greater than naturally regenerated trees because they have occupied the site for a longer period of time.

Downed CWD would exhibit some decay and support a longer burning period. A duff layer would not be well established and would be unable to contribute to soil heating (Brown et al, 2003). High severity fire could be substantial where a large proportion of the soil surface was directly overlain by large woody material (Brown et al, 2003). In areas where salvage and fuel treatments are accomplished a lower percentage of the area would be directly overlaid by large woody material.

Fuel model 6 (shrub) would characterize the fuel condition due to the anticipated dominance of shrubs. A portion of the area would also be characterized as fuel model 10 due to the relatively high level of larger woody fuels. Potential fire behavior increases during this period due to the increased fuel bed depth, fuel loading and arrangement. Potential flame lengths would be in excess of 10 feet under severe conditions and 2 - 4 feet under moderate conditions. Wildfires would tend to be surface fires, potential for tree torching and crowning would be high depending on the density and continuity of regenerated trees. Potential for spotting would be low to moderate due to reduced snag levels. Fewer control problems would be experienced by suppression forces responding to wildfires primarily due to lower potential fire intensity 4 ft flame lengths, spread rate (high in fuel model 6) and less resistance to control due to lower levels of down fuel.

Table 3.48 Biomass Projections for Treated Units

Year	% of Total Biomass as Surface Fuels <6 inches Diameter (avg %)	% of Total Biomass as Surface Fuels >6 inches Diameter	% of Total Biomass as Surface Fuels	Estimated Total biomass onsite (Range tons per acre))	Comments
2002 (Pre-fire)	11	5	16	90 - 170	Pre-fire conditions reflect the absence of disturbance from fire; dense multi-strata forest conditions dominate the area. Total biomass is relatively high with a small percentage as surface fuels.
2010	26	40	66	30 - 60	Total biomass has been reduced by the Davis Fire, Salvage and fuels treatment. Average total reduction is about 50 - 66%. Surface fuels percentage increases as dead material falls. Fuels less than 6 inches diameter are proportionately higher due to faster fall rates.
2020	21	59	80	25 - 40	This point in time represents the minimum amount of biomass present on burned and salvaged sites. Reductions due to the fire salvage and decay are high and additions from new growth haven't compensated for the losses. A high percentage of biomass is surface fuels.
2045	21	56	78	28-45	Total biomass is increasing due to new growth of trees, shrubs and other ground vegetation. Large (> 6 inches diameter) surface fuels dominate, most of the smaller size material has decayed
2060	12	31	43	45 - 60	Total biomass is increasing due to new growth of trees, shrubs and other ground vegetation. Large (>6 inches diameter) surface fuels dominate, most of the smaller size material has decayed.
2100	8	12	20	70 - 95	Large increases in total biomass on site due to new growth off-setting losses due to decay. Surface fuels composition is less than untreated sites and represent a lower hazard of damage to vegetation and soils.

Table 3.49 Amount of Project Area with Fuel Loading not Exceeding 10-35 Tons Per Acre

Effects Indicator	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Acres where Fuel Loading does not exceed 10 – 35 tons per acre	4,230	10,649	10,453	6,906	8,054
Percent of project area	20%	51%	50%	33%	38%

Table 3.49 shows that Alternatives B and C create conditions on more of the recovery area where the fuel loads are within the ranges recommended in the Davis Late Successional Reserve Assessment. For ponderosa pine stands the recommended range is 10 – 15 tons per acre; for mixed conifer the range is 12 – 24 tone per acre; and for mountain hemlock the range is 23 – 35 tons per acre. Brown et al (2003) determined "optimum" levels of down coarse woody debris for soil and wildfire considerations (see Appendix D, page D-5). The optimum levels for wildlife including standing and down was 5-20 tons per acre on dry forest types and 10-30 tons per acre on other forest types. Alternatives B and C produce these conditions on more of the project area than the other alternatives and Alternative A would have these conditions on the least amount of the project area.

Wildlife

- **Threatened and Endangered Species**
- **Regional Forester's Sensitive Species**
- **Management Indicator Species**
- **Birds of Conservation Concern**
- **Deer and Elk Habitat**

Threatened and Endangered Species

A Biological Assessment (BA) has been prepared in compliance with the requirements of Forest Service Manual (FSM) 2630.3, FSM 2672.4 and the Endangered Species Act (ESA) of 1973 (Subpart B: 402.12, Section 7 Consultation, as amended) on actions and programs authorized, funded, or carried out by the Forest Service to assess their potential for effect on threatened and endangered species and species proposed for federal listing (FSM 2670.1).

Those species thought to occur presently or historically on the Deschutes National Forest and analyzed in this document include the Canada lynx (*Lynx Canadensis)*, the northern bald eagle (*Haliaeetus leucocephalus)*, and the northern spotted owl (*Strix occidentalis).* The Oregon spotted frog (*Rana pretiosa)* is also included because its ESA status is under review.

Table 3.50 Threatened and Endangered Species Summary

Species	Status	Habitat	Presence
Canada Lynx	Federal Threatened	Subalpine fir w/ Lodgepole	No habitat
Northern Bald Eagle	Federal Threatened, Management Indicator Species (MIS)	Lakeside, Large trees	Documented
Northern Spotted Owl	Federal Threatened, MIS	Old Growth Mixed Conifer	Documented

Table 3.51 Summary of Conclusion of Effects, Threatened and Endangered Species

	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Canada Lynx	NE	NE	NE	NE	NE
Northern Bald Eagle	LAA	NLAA	NLAA	LAA	NLAA
Northern Spotted Owl	LAA	NLAA	NLAA	LAA	NLAA
Northern Spotted Owl Critical Habitat	NE	NE	NE	NE	NE

Canada Lynx, *Federal Threatened*

The Canada Lynx is a federally listed Threatened species. The Forest Wildlife Biologists for the Deschutes and Ochoco National Forests, and the Crooked River National Grassland have made a determination based on the best available science, that neither Canada lynx nor their habitat are currently present on these administrative units. There is only one verified Canada lynx record from the Deschutes National Forest collected near Lava Lake in 1916 and only 12 verified records in Oregon since 1897. Most of the verified lynx records in Oregon coincide with population peaks of lynx in Alaska and Canada. Self-maintaining lynx populations in Oregon have not existed historically, and lynx occurrence here is likely the result of dispersal from occupied areas with declining prey populations (Verts and Carraway 1998; McKelvey and Aubrey 2001). Surveys for lynx were conducted on the Deschutes National Forest in 1999, 2000, and 2001. There were no lynx detections confirmed from the survey effort.

The Lynx Biology Team reported that all investigations into lynx habitat in the southern part of its range shows an association between lynx and lodgepole pine cover types within the subalpine fir series. The best scientific information available suggests that subalpine fir plant associations capable of supporting a minimum density of snowshoe hares is a reasonable surrogate for describing lynx habitat conditions to support survival (primary vegetation to support survival and reproduction and constitute a Lynx Analysis Unit (LAU)). In addition, the Lynx Conservation Assessment and Strategy (Reudiger et al 2000) identified the need for at least 10 square miles of primary vegetation to support lynx survival and reproduction and constitute an LAU. On the Deschutes NF, four subalpine fir plant associations (subalpine fir-Engleman spruce, alpine parkland sedge, alpine parkland woodrush, and alpine parkland sagebrush) could be considered primary vegetation that could contribute to lynx habitat. In total, about 3,650 acres of subalpine fir plant associations occur across the entire Forest and most of those (3,500) are "parklands" which do not support snowshoe hare. Therefore, there is not an adequate amount of primary vegetation to identify any lynx habitat or a Lynx Analysis Unit on the Deschutes National Forest.

For these reasons, implementation of the No Action or any Action Alternative proposed in the Davis Fire area would have "No Effect" on the Canada lynx or their habitat.

Bald Eagle, *Federal Threatened, MIS*

Existing Condition

The northern bald eagle is currently a federally listed Threatened species in the state of Oregon although a de-listing proposal was initiated on July 6, 1999. At this time no decision has been made regarding the proposal. A detailed account of habitat requirements can be found in the Pacific Bald Eagle Recovery Plan (USDI 1986) but generally speaking, bald eagle nesting territories are normally associated with lakes, reservoirs, or rivers. Nests are usually found in large conifers in uneven-aged, multi-storied stands and several nests are common in a nesting territory. East of the Cascade range in Oregon, eagles prefer nesting in ponderosa pine trees that average 46 inches in diameter (range 21-76 inches) and tend to be larger than surrounding trees (Anthony et al 1982). Roost stands generally average 20 inches diameter breast height (dbh) (range 13-40 inches) with an average height of 91 feet (range 50-125 feet).

The Recovery Plan designated Recovery Zones for each state and the Deschutes National Forest is within the High Cascades Zone. The Recovery Plan population goal for the High Cascades is 33 territories and the Habitat Management goal is 47 territories. Surveys conducted in 2002 confirmed the presence of 52 occupied territories of 58 territories located in the Deschutes River basin. There are six nest territories within the Davis project area. The nest territories include Round Swamp, Wickiup Reservoir South, Davis Lake Southeast, Davis Lake Northwest, Davis West, and Lava Flow. In 2003, prior to the fire, all but Wickiup South were occupied with young. Surveys of bald eagle territories were completed in 2004. All territories were occupied. Table 3.82 on the following page displays the status of each nest territory in the project area.

Table 3.52 Bald Eagle Nest Territories and Yearly Status

Territory Name	Year Located	Status 95	Status 96	Status 97	Status 98	Status 99	Status 00	Status 01	Status 02	Status 03	Status 04
Davis Lake NW	1973	1	oF	2	F	oF	F	1	1	l/n	o
Davis West	1985	al	RT	RT	al	al	al	al	1	l	2
Wickiup Res S	1978	oF	F	1	2	oF	oF	oF	oF	oF	1
Round Swamp	1971	oF	oF	oF	1	2	oF	F	2	2/n	2
Lava Flow	1993	oF	1	F	1	1	1	2	2	2	o
Davis Lake SE	1971	1	F	oF	oF	F	2	2	oF	2	1

al = alternate nest
 # = Number of young fledged
RT = Nest used by Redtail Hawk
/c = Nest used or locations uncertain; need to determine territories
/d = Downy
n = nest burned by wildfire
F = Failure; nest with evidence of eggs, but no fledged young (active or nesting failure)
o = Occupied
oF = Site occupied, at least one adult and a nest observed during breeding season; no evidence of eggs or failure)

The Deschutes National Forest Plan designated Bald Eagle Management Areas (BEMAs) (USFS 1990). There are four BEMAs along Davis Lake, and the South Wickiup BEMA along Wickiup Reservoir. Approximately 2,440 acres (64%) of the 3,831 acres in Davis Lake BEMAs and 1,080 acres (33%) of the 3,228 acres in South Wickiup BEMA are within the project area (figure 3.13). Management direction in the Deschutes LRMP for BEMAs includes precommercial thinning and timber harvest to achieve eagle habitat objectives and in catastrophic siturations, all efforts are to be made to protect or create suitable eagle habitat (M3-4, 5, 6, 7 page 4-94). It also calls for protection of all existing nest, roost, and perch trees which are defined as 110 feet in height and 40 inches or greater in diameter (M3-11, 12, page 4-95).

Due to a lack of fire that historically occurred in ponderosa pine/Douglas-fir stands, there was more roosting habitat in larger blocks than probably occurred under a normal fire regime. Approximately 1,230 acres of the 2,440 acre total along Davis Lake was high quality roosting habitat having 2 or 3 canopy layers with an overstory component of late-successional ponderosa pine, Douglas-fir, sugar pine or some combination. The understory in these stands was comprised of the same species but also included white fir and lodgepole pine. The highest quality roosting habitat was present along Wickiup Reservoir and the east side of Davis Lake. The lack of multi-canopied late-successional forested habitat along west Davis Lake reduced the quality of roosting habitat there.

Postfire

Of the 7,059 acres of BEMAs in and adjacent to the fire, 3,520 acres (50%) were inside the fire perimeter and 2,926 acres (41 %) burned uncharacteristically hot with high or moderate intensity. Low intensity burns did not damage the large diameter ponderosa pine or Douglas-fir, however much of the understory lodgepole pine and white fir is expected to die. The major loss of eagle habitat occurred on Davis Lake where 2,355 acres of the 3,831 acre BEMAs burned; 2,010 acres (52%) with high intensity. Little is known of eagle response to burned habitat. Isaacs (2003) found that most of the bald eagle nests in Oregon were in live trees, but pairs continued to use nest trees that had died. Approximately 3,660 acres of BEMAs around the project area remain unburned.

During fire suppression, the Davis Fire incident management team assigned several Resource Advisors to advise suppression actions as it related to the welfare of Threatened and Endangered species. Suppression effects to habitat were limited in BEMAs. Burn out to secure fire line along the 44 and 6220 Roads and stand replacement fire reduced suitable roosting habitat on 240 acres (moderate and high intensities). Low intensity burn areas

currently retain multiple structures. Although felling of hazard trees by fire crews potentially reduced nesting structures, no known nest trees were felled.

Suppression activities occurred directly under, over, and adjacent to three bald eagle nests that eventually survived the fire. Adults were probably stressed, but they continued to return and feed young left in the nest. In two instances suppression crews directly saved occupied nest trees by placement of fire line. On June 30th, the nest at Lava Flow campground was unburned, there was a juvenile in the nest and an adult nearby. Fire was actively burning towards the tree 100 yards to the east. Fire personnel dug line from the 850 road down to Davis Lake effectively holding the fire for the duration. The Davis Northwest pair had one nestling observed June 5, but the nest burned and it is unknown the outcome of that pair or young. The nest tree at W Davis was found actively burning by resource advisors July 2nd. There was one juvenile in the nest and one adult flying around. The resource advisors pulled a crew to work on the spot. The crew was under the tree putting out the fire on it and adjacent hot spots for an hour. The adult left the immediate area while crew was present. The nest was checked several days later and an adult was observed feeding the young in the nest. The South East Davis nest was several hundred feet off of road 4600855, where fire had occurred the first day. There was one of two juveniles observed in the nest. Adults and another juvenile were seen at various times during monitoring. The 4600855 road was heavily used by those accessing East Davis Campground for evacuation, suppression, and mop-up. All young fledged before the end of July. There have been sporadic sightings of adults and juveniles around Davis Lake and Wickiup reservoir throughout the fall of 2003.

Table 3.53 Wickiup BEMAs Baseline Acres, Loss from Fire, Loss from Suppression

BEMA	Intensity	Acres within Davis Fire	Fire Burn Acres	Suppression Burnout Acres
Wickiup 3,228 acres	Unburned	45	0	0
	Low	118	53	66
	Moderate	505	409	96
	High	411	394	17
Total		1,079	856	179
% of BEMA		33%	27%	6%

Table 3.54 Davis BEMAs Baseline Acres, Loss from Fire, Loss from Suppression

BEMA	Intensity	Acres within Davis Fire	Fire Burn Acres	Suppression Burnout Acres
Davis 3,831 Acres	Unburned	86	0	0
	Low	345	195	150
	Moderate	613	567	46
	High	1,396	1,316	81
Total		2,441	2,078	277
% of BEMA		64%	54%	7%

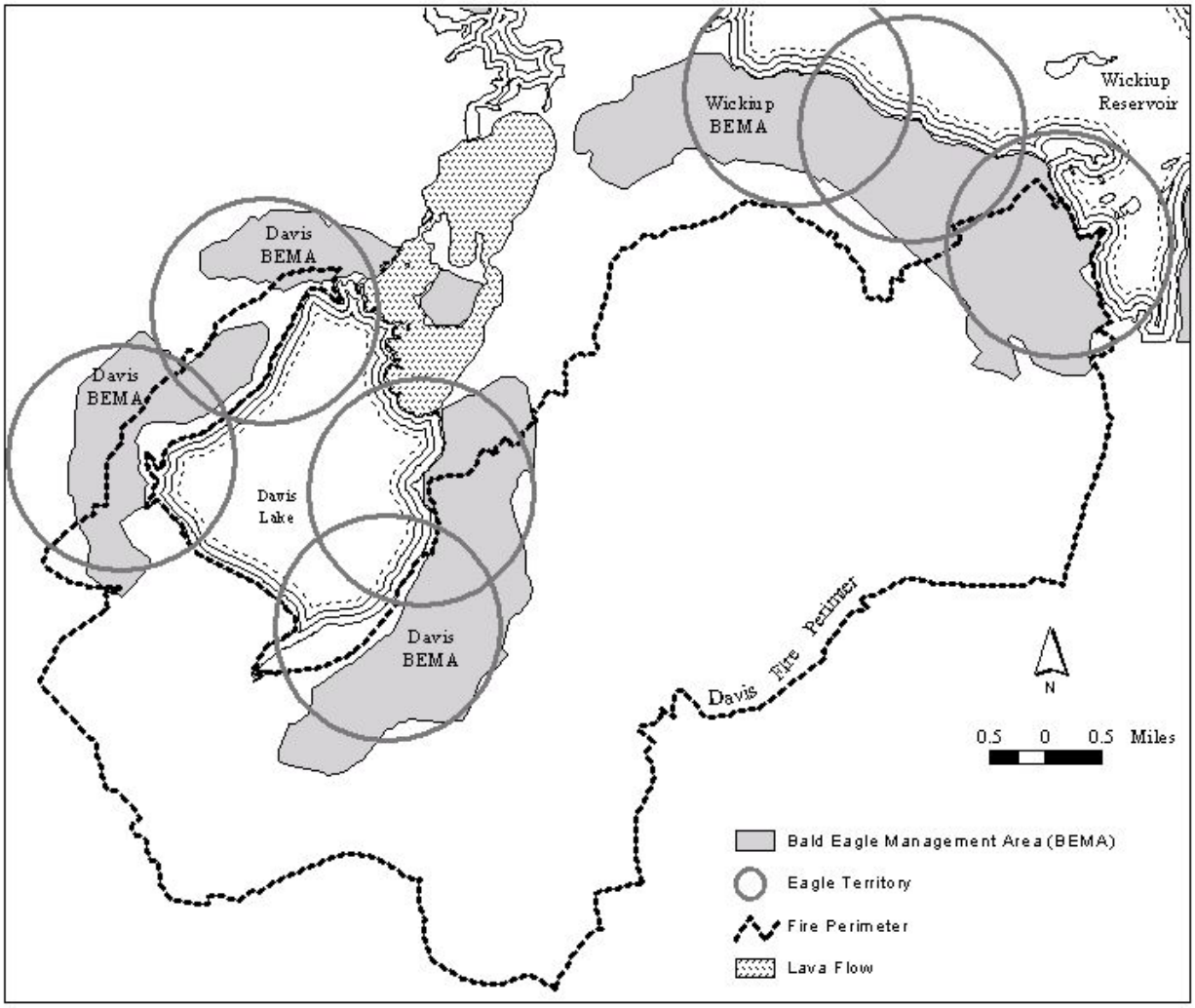


Figure 3.20 Location of Bald Eagle Management Areas and Eagle Territories in and Adjacent to Davis Fire

Roads Analysis

An access plan has been implemented since the fire in order to close all but major roads through the BEMAs. Changes to that plan will take place in the spring, allowing additional access to the fire area, but no increase in open roads through the BEMAs.

A roads analysis was completed in October 2003 to determine the status of the current transportation system and need for changes to that system. There are six (6) bald eagle territories in the roads analysis/Davis Fire area: four around Davis Lake and two associated with Wickiup Reservoir. The Wickiup Reservoir territories (Round Swamp and Wickiup Reservoir south) are within a quarter mile of the 44 road. There are dispersed campsites, as well as ATV use in these areas. These sites have consistently not produced young in the last 7 years. Refer to table 3.82 for nest site status.

The four sites around Davis received varying levels of disturbance. Lava Flow is protected with an area closure, and has consistently successfully fledged young since 1998. The Davis Lake NW territory, (¼ mile off of Road 4660), and Davis Lake SE (along the 4600855 road) receives little disturbance from visitors until late summer. Reproductive success is not consistent from year to year. Davis W is also adjacent to Road 4660 and has not been used consistently. Road 4600855 was closed in the fall of 2003, reducing the level of open roads next to

eagle nests. The current access management plan does not propose any changes to main travel routes, and it was determined there would be no effect on northern bald eagles.

Eagle response to human presence and traffic is highly individualistic. Nest failure can be an additive result of many factors, or as a result of a single event, such as a harsh storm. At this time, factors leading to nest failure of these six territories are unknown.

The access plan to be implemented as a result of the fire closes all but the major roads through the BEMAs. Nests adjacent to these major roads would be subjected to similar levels of traffic that occurred prior to the fire.

Evaluation Criteria

Large tree habitat for the northern bald eagle was lost in the Wickiup and Davis Bald Eagle Management Areas (BEMAs) as a result of the Davis Fire. It is important to reestablish and manage trees as quickly as possible to start the process toward the establishment of large tree habitat.

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

1. Total number of acres of planting and fuels reduction within Bald Eagle Management Areas (BEMAs).
2. Stand characteristics in BEMAs at 30, 40 and 100 years.

The Forest Vegetation Simulator (FVS) with Fire and Fuels extensions (FVS-FFE) was used to determine average stand characteristics at 30, 40, and 100 years. The ages 30 and 40 were selected to best show habitat characteristics for a wide range of species. At age 30 many stands would potentially reach a height and canopy closure to provide habitat for dispersing owls, northern flying squirrel habitat, initial bug infestations for black-backed woodpeckers, or consideration for thinning. Forty years was selected to show fall down rates for snags, continued development of stands, as well as consideration for underburning to maintain open structure for development of eagle nest trees. Age 100 was selected to analyze how stand characteristics would evolve (i.e. stand size, snag retention, and snag recruitment). FVS is a modeling tool based on the best information available. It models conditions that may occur given the assumptions of the model. It is not an absolute answer. Used the same for all alternatives, it gives a basis for comparison. For more specifics on FVS-FFE refer to the Silviculture Specialist Report.

Environmental Consequences

Effects Common to all Alternatives

Stand development varies in alternatives by those acres planted and those acres not planted within the BEMAs. Live stands and stands that had mixed intensity burn will not be treated; therefore, development of these stands will not vary between alternatives. Discussion of effects to habitat in these stands is not included in the individual alternatives but is included in cumulative effects section.

Where artificial regeneration does not occur across intensely burned areas, lodgepole pine, a pioneer species, would most likely become established first. Douglas-fir would then establish overtime, followed by ponderosa pine on the buttes and less frost prone areas. A more in-depth description of vegetation succession is given in the Forest Vegetation section of this chapter. Regeneration would be competing with shrubs and grasses. Trees would be slow in establishing in areas of moderate and high intensity burn (100% mortality). Competition and low stocking levels (60-100 trees per acre) would result in smaller stand diameters and lower canopy cover. At age 30 (year 2036), the early stands dominated with lodgepole pine are estimated to reach an average height of 26 feet and provide canopy cover at 3.3%. At age 40 (year 2046) height would reach 32 feet, canopy cover of 5%, and average stand diameter of 6 inches. Modeling shows at age 100 (2106) the unplanted stands still have not moved away from lodgepole to Douglas-fir or Ponderosa pine. Stand height at this age averages 49 feet,

with a 20% canopy cover and an average diameter of 10 inches. There are no longer any snags greater than 20 inches dbh or greater standing in the stands. Roosting structures have not developed even at the low end of the range (13 inches dbh and height of 50 feet) as described by Anthony (1982). Large dominant trees used for nesting and roosting would not be expected to develop for several centuries after this.

Table 3.55 Stand Characteristics with No Planting modeled by Forest Vegetation Simulator (FVS)

Year	Height (ft)	Canopy Cover (%)	Diameter (inches)	Major Species
2036	26	3.3	none calculated	Lodgepole pine
2046	32	5	6	Lodgepole pine
2106	49	20	10	Lodgepole pine

Effects Common to all Action Alternatives

Commercial salvage of fire killed trees and planting of ponderosa pine and Douglas-fir would take place in areas of moderate to high fire intensity at various levels (where there is 100% mortality). By reducing the level of potential down logs, careful reintroduction of prescribed fire can be used at year 30 - 40 in appropriate areas. Planting regimes for open stands with the reintroduction of a more natural fire regime would ensure that trees providing nesting and roosting structure would develop more quickly. At 30 years, treated stands have an average height of 25 feet and a canopy closure of 27 percent. At 40 years, treated stands would have an average height of 35 feet, diameter of 7 inches, and a canopy closure of 39 percent. At 100 years, treated stands would have an average height of 64 feet, diameter of 14 inches and a canopy cover of 58%. Implementation of maintenance underburning after 40 years to keep the stands open would potentially increase average stand diameters and reduce canopy cover.

While the average diameter in the treated stands is still below the 21- 76 inch range that eagles prefer, the species which they prefer, ponderosa pine, is in place and reaching diameters that could be utilized as perch trees or low quality roosting habitat (Anthony 1982). Thinning and/or underburning would further accelerate the development of dominant tree structures that eagles select for nesting and roosting (Anthony 1982, DellaSala et al 1989).

Table 3.56 Stand Characteristics over Time with Planting (FVS) (Ponderosa Pine, Douglas-fir)

Year	Height (ft)	Canopy Cover (%)	Diameter (inches)	Major Species
2036	25	27	none calculated	Ponderosa /Douglas-fir
2046	35	39	7	Ponderosa /Douglas-fir
2106	64	58	14	Ponderosa /Douglas fir

Protection of seedlings includes trapping gophers. Traps without bait would be placed underground and used only where tree mortality from gophers keeps seedlings from becoming established. Only portions of units receiving heavy gopher damage would be trapped. Gophers are not a prey species of eagles. Trapping gophers would not impact eagles.

Mitigations measures were developed to reduce or eliminate disturbance to nesting or roosting northern bald eagles with implementation of any of the action alternatives. For example, restrictions on activity near eagle nests between January 1 and August 31 (see Mitigation section, page 2-33).

Alternative A – No Action

Direct and Indirect Effects

Under the no action alternative, processes would follow natural succession. Prior to the fire many of these stands were above historic tree densities. Fuels in these stands would continue to exceed historic ranges and would exceed limits to allow underburning without extensive mortality to existing green trees. For a more detailed description of fuels, refer to the Fuels section, page 3-16.

Under implementation of Alternative A, all perch trees along the lake would remain. There would be no planting. Approximately 2,009 acres (52%) of Davis BEMAs and 916 acres (28%) of the Wickiup BEMA experienced 100% mortality (tables 3.53 and 3.54). There is nest building evidence outside the fire perimeter on Wickiup where eagles are reestablishing their territories. There is no such evidence as yet as to the use of burned over habitat on Davis. The eagle habitat most substantially affected is on Davis Lake where over 50% of potential habitat has been lost to moderate and high intensity fire.

In the long term there would be 2,925 acres of BEMA consisting of lodgepole pine trees at various densities, with few to no ponderosa pine or Douglas-fir trees. There would be no nesting or roosting habitat provided for an estimated 100+ years.

Alternatives B and C

Direct and Indirect Effects

Alternatives B and C reduce the level of fire killed trees on 1,390 acres or 48% of the moderate and high intensity (100% mortality) burn areas of the BEMAs. Salvage activities would occur on 1,250 acres within the Davis Lake BEMAs and 140 acres Wickiup BEMA. Planting would take place in harvest units and an additional 201 acres of fire killed plantations (176 acres in Davis Lake and 25 acres in Wickiup BEMAs). Salvage and planting of ponderosa pine result in conditions that allow reintroduction of fire (see Fire and Fuels section). Maintenance of ponderosa pine stands with prescribed fire would simulate historic conditions and create stand structure favorable to bald eagles more quickly than if left to "natural" succession. This would leave approximately 507 acres or 15% of Davis Lake BEMAs and 742 acres or 23% of Wickiup BEMA untreated with habitat in a condition that has low value to bald eagles. Effects of untreated areas would be similar as discussed under Alternative A.

Treatments would reduce the number of potential perch trees along Davis Lake. The reduction would have little effect on bald eagles as there are sufficient numbers of perch snags to select from. All large diameter snags (≥ 36 inch dbh) would be retained as well as those snags closest to the lake. Harvest units are farther upslope in the Wickiup BEMA and perch trees along the lake would be retained. Fuel treatments take place adjacent to Wickiup Reservoir, but diameter of trees removed is 12 inches or less. No cut buffers of at least 200 feet would be placed around winter roost sites and historic nest sites that were burned over. Surveys for 2004 show all territories are occupied. The nonnesting pair at Davis Lake NW built a new nest 150 yards away from the burned over nest site of 2003, but did not use it. The nonnesting pair at Davis Lake SE territory did not show any signs of nest building at either nest site within that territory. Ongoing monitoring would ensure new nest sites are protected. Differences between alternative B and C are in the implementation. Alternative C utilizes more helicopter harvest to reduce impacts to the soils. Mitigation measures for eagles restrict activities, such as harvest and helicopter flight, during the nesting period to eliminate disturbance.

Approximately 530 acres of fuels treatments along roads 46, 4662, and 44 would reduce ladder fuels resulting in reduced fire risks to the remaining nest groves along Wickiup and Davis Lake. Fuels treatments take place in the full range of mortality from low to high. Because of a prescription that favors retention of pre-fire conditions, reintroduction of prescribed fire is not a likely option. These areas would be retained in this condition to provide a range of habitat for those species that depend on forests that remain in a mosaic of fire intensities.

Planting in 1,590 acres of the BEMA would initiate development of perch, nesting, and roosting habitat in the BEMAs. In the long term, (more than 100 years, there would be 1,335 acres of lodgepole pine trees of various densities, with few to no ponderosa pine or Douglas-fir trees, and no nesting or roosting habitat. See table 3.57 for a comparison of effects to BEMAS by alternative.

Alternative D

Direct and Indirect Effects

The effects associated with a passive management scenario in Alternative D for bald eagles is very similar to those discussed for Alternative A. There would be a delay in replacement of those tree species suitable for nesting and foraging. Also, reintroduction of accelerated stand development in actively managed areas would be at a much lesser extent than in Alternatives B, C, or E. Alternative D removes a portion of fire killed trees on 140 acres within the Wickiup BEMA. No treatments would occur within the Davis Lake BEMAs. Planting would occur within harvest units and an additional 40 acres of fire killed plantations within Wickiup BEMA. This alternative would leave 2,009 acres or 52% of Davis Lake BEMAs and 736 acres or 23% of Wickiup BEMA in its existing post-fire condition. Effects of untreated areas would be similar to Alternative A.

Proposed Hazard tree removal along 9 miles of roads 6230, 6240 and 6245 is outside of the BEMAs. Eagle use in this area would be incidental if any. Removal of hazard trees would not affect their use or habitat.

Approximately 780 acres of fuels treatments along roads 46, 4662 and 44, reduces fire risks to the remaining nest groves along Wickiup and Davis Lake. The additional acres of non-commercial fuels treatments proposed in this alternative occur in units proposed for commercial harvest in the other alternatives. Treatments would not necessarily allow reintroduction of fire. Because of a prescription that favors retention of pre-fire conditions, reintroduction of prescribed fire is not a likely option. These areas would be retained in this condition to provide a range of habitat for those species that depend on forests that remain in a mosaic of fire intensities.

In the long term there would be 2,745 acres of lodgepole pine trees of various densities, with few to no ponderosa pine or Douglas-fir trees, no nesting or roosting habitat. Approximately 180 acres would have nesting and/or roosting habitat developing.

Alternative E

Direct and Indirect Effects

Alternative E actively manages about 1/3 of the acres within BEMAs as in Alternatives B and C. It proposes commercial removal of some of the trees on 520 acres, approximately 480 acres within the Davis Lake BEMAs and 40 acres within the Wickiup BEMA. In addition to the harvest units approximately 250 acres of fire killed plantations would be planted, approximately 210 acres in Davis Lake BEMAs and 40 acres in Wickiup BEMA. This would leave 1319 acres or 34% of Davis Lake BEMAs and 836 acres or 26% of Wickiup BEMA untreated.

Approximately 530 acres of non-commercial fuels treatments along roads 46, 4662 and 44, reduces fire risks to the remaining nest groves along Wickiup and Davis Lake. However, treatments would not necessarily allow reintroduction of fire, and effects would be similar to those described in Alternatives B, C, and D for the non-commercial fuels reduction.

In the long term (100+ years) there would be 2,155 acres of lodgepole pine trees of various densities, with few to no ponderosa pine or Douglas-fir trees, no nesting or roosting habitat. Approximately 770 acres would have nesting and/or roosting habitat developing.

The following table displays the figures for acres treated/untreated by Alternative. The expected forest conditions for treated/untreated are displayed in tables 3.55 and 3.56. The areas untreated by each alternative can be expected to develop as shown in table 3.55; and the areas salvaged and planted can be expected to develop as shown in 3.56.

Table 3.57 Comparison of Effects to BEMAs by Alternative

	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
BEMA Acres Treated (percent of BEMAs)	0	1,390 (20%)	1,390 (20%)	140 (2%)	520 (7%)
BEMA Acres Planted (percent of BEMAs)	0	1,590 (22%)	1,590 (22%)	180 (2%)	770 (11%)
Acres of 100% mortality left untreated	2,925	1,335	1,335	2,745	2,155
% Davis (3,381 acres) BEMAs Untreated	52%	15%	15%	52%	34%
% Wickiup (3,228 acres) BEMAs Untreated	28%	23%	23%	23%	26%

Cumulative Effects All Alternatives

The Davis Fire reduced bald eagle nesting and roosting habitat by approximately 2,900 acres. Reduction of habitat by construction and rehabilitation of firelines, handline and tractor and felling of hazard trees was minimal and included in the total acres of suppression habitat loss. To make roads safe for public travel, roadside hazard tree salvage was completed. Hazard trees along the routes open to the public were removed. Very few, less than 0.1 snags/acre, were removed from the BEMAs.

Nesting and roosting habitat for bald eagles would continue to be available in unburned portions of the BEMAs on Davis Lake, 48% and 72% of the Wickiup BEMA. The initial stages of development of future nesting and roosting habitat varies by alternative from 0 in Alternative A to 1,390 acres in Alternatives B and C. Outside of the proposed salvage there is no timber harvest planned within the project area in the foreseeable future.

Vegetation management project areas that overlap with the Davis Fire include Seven Buttes, Seven Buttes Return, and Charlie Brown. Seven Buttes (USDA 1996) proposed 929 acres of understory treatments within 9,125 acres of BEMA (Wickiup, Davis and Odell Lake) land allocation within the Seven Buttes planning area. Seven Buttes Return (USDA 2001) proposed commercial thinning, salvage, and individual tree culturing of 1,466 acres in the same BEMAs as Seven Buttes. Both proposals would not reduce nesting habitat, but would reduce roosting habitat. Similarly, the Crescent Lake WUI (wildland-urban interface) project Environmental Assessment was recently completed. The project will reduce fuel loadings adjacent to the community of Crescent Lake as well as high use campgrounds, resorts, and a Boy Scout camp. Within the proposal 100 acres of BEMA is to be thinned from below.

Roosting habitat is largely composed of multistoried stands with large trees. The quality of roosting habitat would be reduced for 1-2 decades as some of the understory lodgepole pine and white fir are removed to reduce competition and risk to insects and disease. However, within the watershed, there would be sufficient areas for roosting until other areas of recent active management can provide this type of habitat. Increased growth would occur in the residual trees, providing the large dominant trees that the eagles prefer (Anthony et al 1982). Over time quality roosting habitat would increase where multi-story stands are being maintained and allow bald eagles greater protection from winter storms. The biological evaluation for Seven Buttes Return and Crescent Lake WUI made the determination of May Effect Not Likely to Adversely Affect bald eagles do to the reduction in roosting habitat. The U.S. Fish and Wildlife Service concurred with both determinations in separate biological opinions.

The Bend/Fort-Rock Ranger District prepared an environmental assessment (Charlie Brown) which proposes similar vegetative and fuels treatments as described for Seven Buttes Return. The Charlie Brown Biological Evaluation identified 1,835 acres of silviculture and fuels treatments in the preferred alternative within 11 BEMAs of the project area. A percentage of these treatment areas would occur within the Wickiup and Browns subwatershed that overlap with the Seven Buttes, Seven Buttes Return and Davis Fire Recovery project areas. Commercial and pre-commercial thinning, large tree culturing, mistletoe control, and fuels reduction by fire are projected to occur within the Bend/Ft. Rock BEMAs. The biological evaluation stated there would be few minor, short-term negative effects on bald eagles from only a few harvest units and overall, a Beneficial Effect determination was made for both action alternatives. The U.S. Fish and Wildlife Service concurred with this determination in a biological opinion.

Additional silvicultural entries are expected in the future within BEMAs outside the project area to further reduce stand susceptibility to insects and disease. All planning efforts would take into consideration previous silvicultural treatments, existing conditions, and current management direction for northern bald eagles.

Another activity that may occur within the planning area is harvest of mushrooms that typically come in after a fire, such as morels. These mushrooms are generally associated with upland habitats. While there would be more activity the first two years following the fire, the activity is expected to be focused on the slopes of Davis Mountain, Saddle Butte, Hamner Butte, and Round Butte, and away from nest groves.

There are no known northern bald eagle nest sites or winter roost sites on private lands in or adjacent to the project area. Present and future actions on private lands including timber harvest, road construction, and home construction are not expected to have a negative impact on bald eagle territories. This is because most private land acreage is located away from the lakes and reservoirs where bald eagles are currently known to nest.

Recreation and campground improvements would continue to provide a source for potential disturbance. Current plans for the expansion of Lava Flow Campground avoid the existing eagle closure area. Other recreational developments being planned are outside of known eagle nesting territories. The 2004 surveys showed all proposed activities are still 0.25 miles or more away from active nest sites, with 2 pairs not nesting. Until nesting is reestablished by the remaining pairs it is impossible to predict if the planned recreational improvements will affect eagles. Potential effects range from abandonment of territories, reduced or inconsistent productivity, to no effect.

Treatment of noxious weeds is an ongoing project along major roads within the planning area. Spot treatments (less than an acre) include manual, mechanical removal of weeds, as well as chemical treatments with the herbicide Dicamba. Dicamba is a benzoate auxin herbicide that mimics a plant hormone in broadleaf plants (Syracuse Environmental 2004). It causes a hormone imbalance resulting in abnormal growth in the plant to a degree that the plant life processes no longer work and the plant dies. The hormonal imbalance is specific to plants. Studies on toxicity to animals have found at high doses (above recommended application levels) the chemical can cause skin and eye irritations (Syracuse Environmental 2004). It does not bioaccumulate. Treatments would have no effect on northern bald eagles.

Overall nesting habitat for bald eagles would be retained. The quality of roosting habitat will change over time. The future of eagle use of two burned-over nesting territories on Davis Lake will be determined with continued monitoring.

Determination

The Davis Fire Area had higher than historical levels of fuel loadings. The fire burned with higher than historical intensities. As a result the BEMAs suffered a higher loss of habitat than would have occurred under a natural ponderosa pine fire regime. Treatments are designed to assist in correcting fuels and vegetation densities without several burn cycles. Mitigations measures would reduce or eliminate disturbance to nesting or roosting bald eagles with implementation of any of the action alternatives.

The 2004 surveys showed eagles using historic nest trees that were burned. Only two pair were nonnesting, the Davis NW and Lava Flow territories were occupied, but nesting was not established. The Lava Flow pair were in the vicinity of established nests. The Davis NW pair started a new nest in a burned tree in the vicinity of the old established nest. These two pair may remain in flux. The Davis West nest tree is a ponderosa, still green,

and appears to be surviving the bole scorch it received. Both Wickiup pairs reestablished nests in historic nest trees, both killed by the fire. Utilizing the fire-killed nest trees could be short lived as ponderosa pine snags would fall within the next 15-30 years. Without planting ponderosa pine and Douglas-fir the forest that would develop would consist almost entirely of lodgepole pine – not the ponderosa pine they prefer for nesting. Without salvage, fire could not be reintroduced without destruction of any regeneration. Fire could not be used as a tool to develop any dominant overstory. The delay in development of habitat and the inability to return to a historic fire regime, affecting 52% of the area within Davis BEMAs, effectively eliminates two nesting territories on Davis Lake for centuries. Implementation of **Alternatives A and D May Effect, Likely To Adversely Affect bald eagles.**

Proposed actions in Alternatives B, C, and E, move varying portions of the intensely burned areas to habitat, and return varying numbers of acres to a more historic fuels regime. Planting ponderosa pine and Douglas-fir would provide the preferred tree species for nesting. Reduction of fuels would allow for the use of fire to manage stands to develop dominant structures also preferred for nesting. The amount of potentially unusable habitat in Davis BEMA would be reduced over time from 52% to 15% for alternatives B and C and 34% in Alternative E. In the long term, habitat more suitable for bald eagle nesting and foraging would develop sooner on 770-1590 acres of ponderosa pine and Douglas-fir habitat. In the short term it is unknown to what extent eagles would utilize the burned over sites. They may not use past nest territories. They may only use the snags adjacent to the lake for perching. Although there would be a wide variety and number of perch trees to choose from, there would be a reduction in the total number of potential perch trees. Implementation of **Alternative B, C, or E May Effect, Not Likely To Adversely Affect bald eagles.**

Northern Spotted Owl, *Federal Threatened, MIS*

Existing Conditions

Spotted owls generally require mature or old-growth coniferous forest with complex structure including multiple canopy layers, large green trees and snags, heavy canopy habitat, and coarse woody material on the forest floor. Nesting, roosting, and foraging (NRF) habitat for the northern spotted owl on the Deschutes NF includes stands of mixed conifer, ponderosa pine with white fir understory, and mountain hemlock with subalpine fir. Suitable nest sites are generally in cavities in the boles of either dead or live trees. Platform nests may also be used (but more rarely), which include abandoned raptor nests, broken treetops, mistletoe brooms, and squirrel nests (USDA 2003). Relatively heavy canopy habitat with a semi-open understory is essential for effective hunting and movement.

Habitat conditions that support good populations of northern flying squirrels (*Glaucomys sabrinus*), western red-backed voles (*Clethrionomys californicus*), and other nocturnal or crepuscular small mammals, birds, and insects are essential to supporting spotted owls. Analysis of local owl pellets shows the primary prey is northern flying squirrel, with red-backed voles, snowshoe hair, western pocket gopher, bushy-tailed woodrat, voles, mice, and insects as secondary prey.

All but 8% of the project area is within the range of the northern spotted owl and under management allocations of the Northwest Forest Plan (NWFP). Approximately 11,820 acres of the 48,890 acre Davis Late Successional Reserve (LSR) are within the Davis Fire perimeter including 7,292 acres of Critical Habitat Unit (CHU) OR-07. Prior to the fire there was approximately 5,759 acres of nesting, roosting and foraging (NRF) habitat in the project area. The breakdown included 4,370 acres of NRF within the LSR/CHU; 1,286 acres in Matrix; and 103 acres in the Administratively Withdrawn allocation. Habitat fragmentation as a result of past timber harvest was relatively common on the buttes, although large consolidated blocks of NRF habitat were still present on Davis Mountain and along the west side of Hamner Butte. These blocks in combination with dispersal habitat provided connectivity west of Davis Lake, and north and south between owl home ranges and LSRs.

Table 3.58 Spotted Owl NRF Habitat by Allocation

Allocation	Acres within Project area	Acres that were NRF
LSR	11,820	4,370
CHU only*	(7,292)	(3,523)
Matrix	6,425	1,286
AWD	1,020	103
Outside NWFP	1,735	0
Total	21,000	5,759 (27.4%)

*CHU acres are included in total of LSR, not additive

Dispersal habitat was generally available throughout the area. Miller et al (1997) found dispersing owls favored old growth structure for dispersal, but utilized many types of forest. Use of open sapling stands during dispersal decreased the probability of mortality, where use of clearcuts increased the probability or mortality. Miller et al tied the increase survival in sapling stands to availability of prey. Dispersal habitat was defined by the Interagency Scientific Committee (Thomas 1990) as stands with an average dbh of 11 inches and a 40% canopy cover. Those conditions are not biologically possible in all eastside plant association groups. The Deschutes National Forest put together a Science Team of experts on local conditions to determined dispersal habitats. The team determined a process by which local biological knowledge of sites would be used to describe dispersal habitat (USDA Letter 1996). The Seven Buttes EA Interdisciplinary Team used this process to determine dispersal habitat in the Seven Buttes Analysis area. The Davis Fire project area is entirely within the Seven Buttes analysis area. The following criteria were used to define dispersal habitat for Seven Buttes and will be used for this analysis also:

Table 3.59 Dispersal Habitat Definition

Plant Association Group	Even-aged Stands Average dbh, Percent Canopy Cover	Uneven-aged Stands Average dbh, Percent Canopy Cover
Mixed Conifer Wet*	11”dbh, 40%CC	11”dbh, 40% CC
Mixed Conifer Dry	8”dbh, 35% CC	11”dbh, 35% CC
Ponderosa Pine	8”dbh, 35% CC	11”dbh, 35% CC
Lodgepole Pine	7”dbh, 30% CC	7”dbh, 30% CC
Mountain Hemlock	7”dbh, 30% CC	7”dbh, 30%CC

*There is no Mixed Conifer Wet PAG within the Davis Fire Project Area

Of the thirteen spotted owl territories on the Crescent Ranger District, five are all or partially within the fire perimeter. This includes all of the Davis Mountain (#2006) owl territory, approximately 3/4 of Saddle Butte (#2008) and very minor portions of Hamner Butte (#2002), McCool Butte (#2001) and Maklaks Mountain (#2004) owl territories. Home range monitoring surveys were partially completed at the time of the fire. Davis Mountain territory had a nesting pair with young. Hamner, McCool Butte, and Saddle Butte had received two surveys prior to the fire, with no responses. Maklaks had one survey prior to the fire with no responses. A survey was conducted one evening prior to the burnout on Davis Mountain in an attempt to locate and lure the pair away from operations. There were no responses.

Additional surveys were completed August 4th and 6th (post-fire) with no responses anywhere except Hamner Butte, where two owls responded. They were located just south of the fireline on Hamner Butte. One was an adult, the other a young of the year. It is unknown if they came from the Davis Mountain area or were on Hamner but didn't respond to earlier surveys. The status of owl home ranges is displayed in the following table.

Table 3.60 Status of Owl Home Ranges

Forest Site Name (Owl Pair Number)	Current NRF w/in 1.2 mi.	Current NRF w/in 0.7 mi.	Status 93	Status 94	Status 95	Status 96	Status 97	Status 98	Status 99	Status 2000	Status 2001	Status 2002	Status 2003
McCool Bt. (#2001)	641	221	unk	unk	NA	Na	NA	NA	unk	NA	unk	unk	NA
Hamner Bt. (#2002)	1,589	603	**R/2**	unk	**P**	**P**	**P**	NA	NA	NA	**P**	**S**	**S***
Maklaks Mt. (#2004)	643	268	unk	unk	**R/1**	**R/1**	**P-1**	**P-1**	unk	NA	unk	**R/2**	**NA**
Davis Mt. (#2006)	1,692	639	NA	**R/2**	**R/1**	**R/2**	**P**	**R/1**	**P**	**R/1**	**S**	**P**	**R/?**
Saddle Bt. (#2008)	1001	368	**P-1**	**R/1**	**P-1**	**R/1**	NA	**R/2**	unk	unk	unk	NA	NA

OS = single site, single bird R/# = pair, nesting attempt/# of young P = pair site, occupied
NA = surveyed; not active P-1 = pair site occupied, 1 bird located unk = unknown site status
? = Davis Mt. had two young in the nest; it is unknown if any survived the fire.
*Not known if this is original Hamner Butte owl or refugee from Davis Mt

Post-fire

Within the project area the fire burned 11,820 acres of the LSR and 6,425 acres of the Matrix allocation. High and moderate fire intensity with 100% mortality occurred on approximately 9,800 acres in LSR and 4,000 in Matrix. The remaining burned area consisted of 1,400 acres in LSR and 1,900 in matrix of underburn or mixed intensities and 620 of LSR and 525 of the matrix remain unburned. The fire without the suppression efforts burned through 4,732 acres of NRF. Suppression strategies resulted in burning of approximately 936 acres of NRF. For three days fire crews focused on the actively burning fronts of the fire on the east side of Hamner Butte and Davis Mountain. During this time the fire continued to back down the north and west sides of Davis Mountain. Burnout efforts on July 4 halted the fire on those fronts. Moderate and high burn intensities resulted in a direct loss of nesting, roosting, foraging, and dispersal habitat on the north, south, and east flanks of Davis Mountain and north east flank of Hamner Butte. The connectivity route identified in the Odell Watershed Assessment and Davis LSRA west of Davis Lake was lost due to the intensity of the burn.

Areas with a low intensity burn were generally underburned with varying degrees of individual tree or patch torching. These areas still retain all the characteristics of habitat. These blocks are extremely important at this time because they are large enough to provide refuge for the Davis owl pair, if they survived, and other old growth dependent species. The mosaic provides habitat for those species that depend on old growth with burned patches (see Snag and Down Wood Section). It is unknown how long the stands will remain habitat. The understories are generally lodgepole pine or white fir, species that do not tolerate underburns and while alive at this point may die later, further increasing habitat loss. Plots have been established in these areas to monitor stand survival.

Habitat loss due to construction and rehabilitation of firelines and safety zones was minimal and is included in burned acres. Drop points and staging areas did not remove any habitat as existing road junctions or wide areas in the roads were used.

Table 3.61 Baseline Acres of NRF, Loss from Fire, Loss from Suppression

Fire Only		Intensity				Suppression Only		Intensity			
Allocation	**Acres**	**Unburned**	**Low**	**Moderate**	**High**	**Allocation**	**Acres**	**Unburned**	**Low**	**Moderate**	**High**
LSR	3,874	12	127	258	3,478	**LSR**	496	31	241	155	68
CHU only*	(3,194)	(8)	(80)	(195)	(2,911)	**CHU only***	(330)	(21)	(139)	(122)	(47)
Matrix	772	6	70	140	555	**Matrix**	514	23	79	243	169
AWD	86	5	15	34	32	**AWD**	17	10	2	4	1
Total	4,732	23	212	432	4,065	**Total**	1,027	64	322	402	238

Suppression efforts occurred within ¼ mile of the Saddle Butte territory. It is believed the site was not occupied; surveys over the last two years (2002, 2003) did not confirm occupancy. Habitat loss was most severe in the Davis Mountain (100%), and Saddle Butte (73%) territories. Approximately 85 acres of NRF in the Davis Mountain home range and 142 acres in Saddle Butte were lost from suppression efforts.

Table 3.62 Home Range NRF Baseline, Loss from Fire, Loss from Suppression

Home Range	Acres of Pre-Fire NRF (1.2)	% of HR*	Fire Loss Acres	Suppression Loss Acres	Acres of Post-Fire NRF (1.2)	Resulting % of HR*
McCool Butte #2001	641	22%	2	0	639	22%
Hamner Butte #2002	1,589	55%	32	0	1,557	54%
Maklaks Mountain #2004	643	22%	1	0	642	22%
Davis Mountain #2006	1,692	59%	1602	82	8	0%
Saddle Butte #2008	1,000	35%	585	144	271	9%

It is unlikely that either Saddle Butte or the Davis Mountain home ranges would be occupied anytime soon. Saddle Butte had marginal habitat and has not been occupied for several years. Davis Mountain had 100% mortality across 100% of the home range. While there is evidence that spotted owls are able to withstand the short-term effects of fire occurring at low to moderate severities (0-70% canopy kill), without displacement, those in high severity (71-100% canopy kill) were displaced to the nearest available habitat, if they survived the fire (Bond et al 2002; Davis, personal comm. 2004).

Davis Late Successional Reserve

Under the Northwest Forest Plan, a reserve network was designed to protect late-successional forest species where habitat conditions are relatively intact and provide for the recovery of late-successional forest habitat where habitat is extremely limited. The intent of LSRs is to "protect and enhance the condition of late-successional/old-growth forest ecosystems, which serve as habitat for dependent or old growth associated species including the northern spotted owl." (USDA 1994, p C-9)

> "Within Region 6 and specifically within the Deschutes National Forest, LSRs provide habitat for species which rely on late structured stands maintained by frequent, low intensity fire

> regimes. These 'fire climax' late successional and old growth stands provide habitats and an array of late successional and old growth related species not usually associated with the 'climatic climax' on the Deschutes Forest or Province. Because of this mix of 'westside' and 'eastside' vegetation types and conditions, management efforts should focus on maintaining the dynamic balance of all the vegetative series, to include both climatic climax and fire climax ecosystems. This will provide opportunities for ecosystem maintenance and restoration for existing and potential natural vegetation." (USFS 1995(a))

The Davis Fire altered 24% (12,000 acres) of the Davis LSR. Approximately 56% of the Davis Restoration Project area is within the Davis Late Successional Reserve (Davis LSR). As required by the NWFP a Late Successional Reserve Assessment (LSRA) was completed to determine what management activities would be appropriate within the LSR. The LSRA was reviewed by the Regional Ecosystem Oversight Office (REO) and approved by letter on August 16, 1996. The REO found that the Davis LSRA provided sufficient context and framework with noted assumptions, for decisions on future projects within the LSR.

The LSRA recognized the unbalanced nature of the vegetation within the LSR. Natural disturbance regimes have been altered by fire suppression and timber harvest. Historically, ponderosa pine plant associations had frequent low severity fires that would maintain open stands with grass and forb in the understory. Mixed conifer would have a mixture of low, moderate, and high severity fires on a 25 – 75 year cycle. Fire size for mixed intensity fires in mixed conifer ranged between 6 – 600 acres (Agee 2002a). Mountain hemlock was probably closest to a natural fire regime with fire return interval between 100-200 years, resulting in stand replacement fires.

The LSRA determined the risk factors in the various management strategy areas (MSAs) and recommended treatments to reduce the risk of insect, disease, and fire. The LSRA included in management options actions to take with the loss of habitat: "If Catastrophic loss of habitat does occur, treat to enhance and obtain LOS habitat characteristics as described in Chapter 3 -Suitable Habitat Condition." Chapter 3 describes by plant association group the amount of down wood, snags, tree seedling, saplings, poles, medium and large trees that should be managed for. Because it does not give specifics on how salvage should occur, a letter was provided in February 2004 to REO describing the proposed action, and how Northwest Forest Plan standards and guidelines were being meet. .

Documents, including several guiding documents, recommend retaining all snags of specific diameters or diameters greater than 20 inches, or recommend limitations on amount of area salvaged.

Recovery Plan for the Northern Spotted Owl – Draft (1994 p 113-114). "Snags from the original stand may be an important component of flying squirrel habitat as forests develop after fire. Although there is some uncertainty concerning the optimum density of snags to be provided for squirrels, management to provide maximum benefit likely for this prey species is an appropriate strategy for DCAs (designated conservation areas). Therefore, snags larger than 20-inch dbh will be retained."

At that time it was believed that the flying squirrel was old growth dependent, and a secondary cavity nester, dependent on snags for denning. Rosenberg and Anthony (1992) found similar densities of flying squirrels in young second growth and old-growth forests in western Oregon. They concluded that flying squirrels may be habitat generalists and not an old-growth dependent species. Because they nest in a variety of structures, cavities in small snags, witches' broom, moss and stick nests, nesting habitat may not limit their abundance. They suggested factors such as food availability, predation and competition with other species limit the abundance of the flying squirrel. Carey et al (1994) specifically studied dens of the northern flying squirrel. They found the majority of dens were in live trees. They recommend management for northern flying squirrel include leaving large fallen trees and large dbh tall stumps, and retain large green trees with platform branching, multiple tops and/or cavities. While retaining snags in burned areas is important to provide options for the flying squirrel, retaining all snags is not. Developing closed canopy stands to provide habitat may be more important following a fire.

The recovery plan recognized that retaining all 20 inch and greater snags may not be appropriate everywhere.

"This guideline may need to be refined for application in some physiographic provinces. However, retention of all stems larger than 20-inch dbh is likely to provide the highest probability of long-term retention of snags throughout the owl's range. In all areas, however, the primary focus should be on long-term planning."

The recovery plan did not refine the guideline for physiographic provinces, set standards on how the refinement may be done or was even finalized. The Northwest Forest Plan did adopt many of the recommendations of the recovery plan. The FWS was heavily involved in the development of the standards and guides for the NWFP.

The Northwest Forest Plan (Final Supplemental Environmental Impact Statement, Appendix G) looked at the relationship of the SEIS to the goals and objectives of the draft recovery plan and the development of the alternatives for the SEIS. "The alternatives for consideration in this SEIS were developed using these (Final Draft Recovery Plan) strategic and biological principles as a basis. This basis was appropriate because the northern spotted owl population and habitat conditions have not changed significantly since the Final Draft Recovery Plan was developed.

Evaluation Criteria

Connectivity between LSRs and home ranges was lost with the Davis Fire. Reestablishment of dispersal habitat between Hamner Butte, Davis Mountain and habitat to the north and west is important in maintaining occupancy on Hamner Butte and reestablishment of occupancy on Ringo Butte (unoccupied since 1998). It also provides additional dispersal routes for Royce and McCool Buttes and Maklaks Mountain.

Mature or old-growth coniferous forest with complex structure including multiple canopy layers, large green trees and snags, heavy canopy habitat, and coarse woody material on the forest floor developed in this area with years of fire suppression. The older overstory, however, developed under a different fire regime. Reestablishment of stands that can be managed with fire early (i.e. first 50-100 years), interspersed with denser dispersal habitat, is needed to adequately provide for spotted owls in the future.

While there is no data to suggest owls or their primary prey benefit from very high densities of snags (Forsman pers. comm. 2004), management of snags is important for future potential nest sites for spotted owls and nesting habitat, and as a food source for its major prey species the northern flying squirrel (*Glaucomys sabrinus*). Both utilize large diameter (18-33"dbh) snags (Buchanan et al 1995, Carey et al 1997) for nesting or resting. There are no specific snag densities recommended for these species as they also take advantage of green trees with advance decay that have cavities produced by woodpeckers, or breakage of large limbs and tops. Down wood and snags provide major food sources for the flying squirrel, whose diet consists largely of fungi, and lichens, as well as nuts, buds, catkins, fruits, insects, tree sap, roosting birds, eggs, and flesh of other vertebrates (Verts and Carraway 1998). Red-back voles, (*Clethrionomys californicus*), secondary prey species, are also associated with down wood and also rely on fungi and lichen. Lacking specific snag and down wood density recommendations for these species, use of historic levels obtained from DecAID will be used. DecAID is a web-based advisory tool to help managers evaluate effects of forest conditions and existing or proposed management activities on organisms that use snags and down wood. It is a summary, synthesis, and integration of published scientific literature, research data, wildlife databases, forest inventory databases, and expert judgment and experience. It utilizes information from vegetation plots taken across the state for a given habitat type. Because the plots cover a broader area than the project area, it may not accurately depict the historic levels of the Davis Fire Area. When used with all alternatives it gives a basis for comparison between alternatives. See the Snag/Down Wood issue discussion for the goals of snag and down wood retention. Mixed conifer habitat is the focus for spotted owls as it can support higher tree densities than ponderosa pine/Douglas-fir. The Forest Vegetation Simulator with the fuels extension was used for modeling snag fall down, tree growth, and snag recruitment.

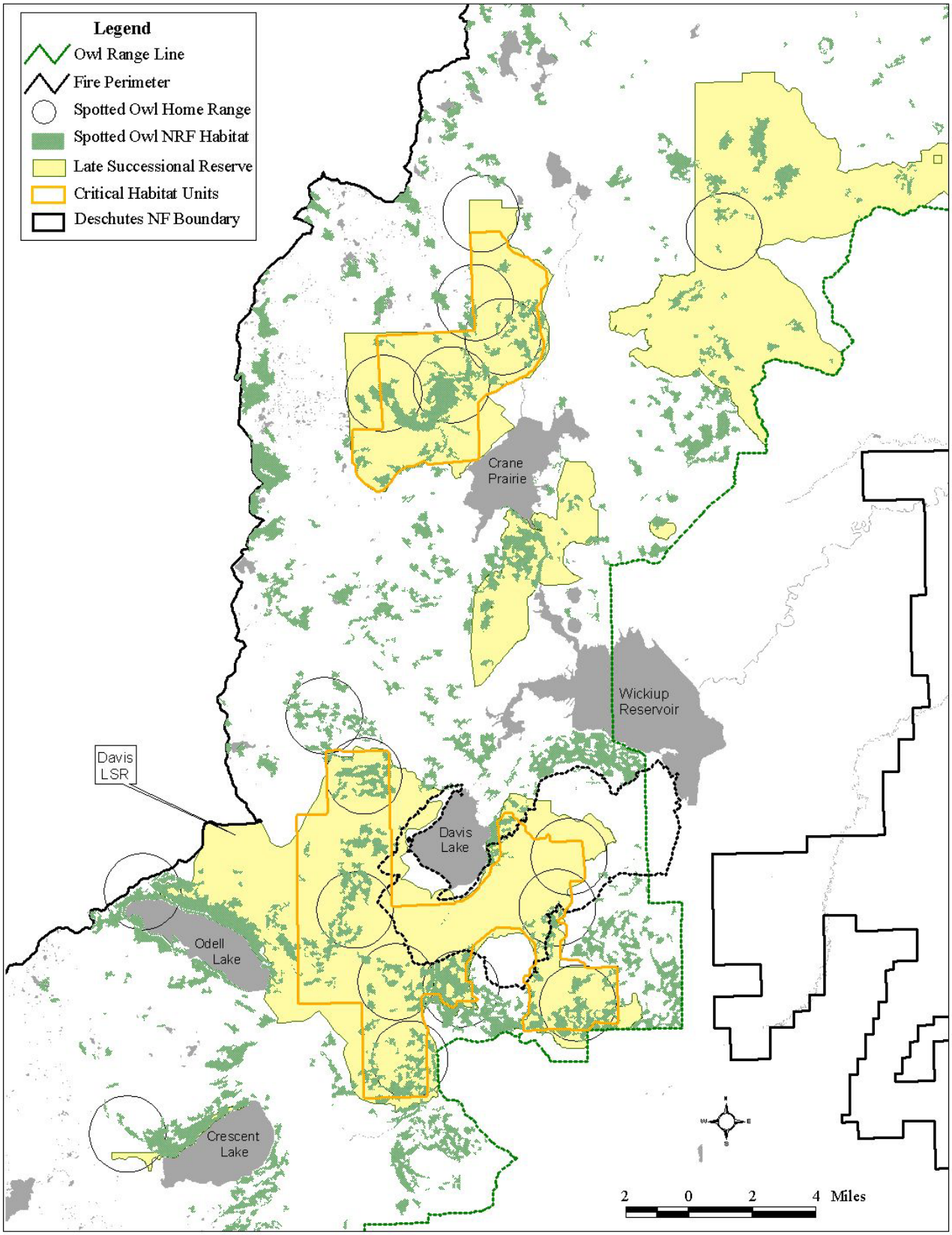
The following evaluation criteria will be used to evaluate the effects of the planned activities:

1. Percent of Northwest Forest Plan area treated and acres reaching minimum dispersal habitat (PP and MC – 8"dbh and 35% canopy closure; LP – 7" dbh and 30% canopy closure) at 30, 40, and 100 years.
2. Mixed Conifer habitat snag levels at 40 years and size of snags being recruited at 100 years.
3. Down wood levels at 40 years.

Analysis Process

The Forest Vegetation Simulator with Fire and Fuels extensions (FVS-FFE) was used to determine average stand characteristics at 30, 40, and 100 years. The ages 30 and 40 were selected to best show habitat characteristics for

a wide range of species. At age 30 many stands would potentially reach a height and canopy closure to provide habitat for dispersing owls, northern squirrel habitat, beginnings for bug infestations for black-backed woodpeckers, or at a stage requiring consideration for thinning. Forty years was selected to show fall down rates for snags, continued development of stands, as well as consideration for underburning for maintaining an open structure for the development of eagle nest trees. Age 100 was selected to see what stand characteristics would evolve stand size, snag retention and recruitment. It must be remembered that FVS is a modeling tool based on the best information available. It gives conditions that may occur given the assumptions of the model. When applied in the same manner for all alternatives, it gives a basis for comparison. For more specifics on FVS-FEE refer to the Silviculture Specialist Report.



Map #18. Late Successional Reserves, Spotted Owl Home Ranges, CHUs, and NRF Habitat

Environmental Consequences

Effects Common to All Alternatives Including No Action

Stand development varies in alternatives by those acres planted and those acres not planted. Because green trees are not harvested, or areas with mixed burn intensity left untreated the development of these stands will not vary across all the alternatives. Habitat in these stands is not included in each alternative but included in cumulative effects.

Where treatment does not occur across the high and moderate intensity burned areas lodgepole pine, a pioneer species would be most likely to establish first. Douglas fir would then establish overtime, followed by ponderosa pine. A more in depth description of vegetative succession is given in the vegetation analysis. At age 30 (2036), the early stands dominated with lodgepole pine, would reach an average height of 26 feet and canopy cover of 3.3%. At age 40 (2046) height would reach 32 feet, canopy cover would be 5%, and average stand diameter would be 6 inches. The model shows at age 100 (2106) the stands still have not moved away from lodgepole to Douglas-fir or Ponderosa pine. Stand height at this age averages 49 feet, with a 20% canopy cover and an average diameter of 10 inches; there are no longer any snags greater than 20 inches dbh or greater standing in the stands. Dispersal habitat would be limited for spotted owls and canopy in established stands may be too open for use by the northern flying squirrel. Brush would be well established and provide habitat for the bushy-tailed wood rat, a secondary prey species utilized by the spotted owl. Diversity of tree densities and stratification of canopies would develop naturally with stand development. Down wood habitat for secondary prey species would be abundant across the landscape. Fuel loadings would remain above historic levels until several fire cycles would reduce them to more natural loadings. See fuels analysis for details on fire regimes.

Table 3.63 Stand Development with No Planting

Year	Ave. Tree Height (ft)	Canopy Cover (%)	Average Diameter (inches)
2036	26	3.3	none calculated
2046	32	5	6
2106	49	20	10

Effects Common to all Action Alternatives

Salvage and planting of ponderosa pine and Douglas-fir would take place in areas of moderate to high fire intensity (100% mortality). The smaller blocks of salvage are being completed in conjunction with fuels treatments to provide strategic areas of reduced fuels to reduce risk to remaining habitat. The majority of the treatments are in the “gut” of the fire, areas that consist of hundreds of acres of 100% mortality without any type of mosaic of green trees from underburns or unburned areas, except for small patches of thinned regeneration stands. While the Bond et al (2002) research indicates owls do not return to areas with 100% mortality, information from the Willamette National Forest (Davis pers. comm. 2004) suggests that owls may return to areas with 100% mortality where red needles remained on the trees. Following the Warner Creek Fire on the Willamette National Forest, numerous pairs were located in their former territories, including a pair nesting in a stand with 100% mortality (the nest tree and a few surrounding trees however still held on to a "red" canopy). The second season the heavily burned areas were abandoned. The Warner Creek Fire burned in the fall and created a highly mosaic landscape. The red needles of trees killed with moderate intensity fire persisted into the spring. Since the Davis fire happened early in the spring, needle drop on red canopy trees was occurring throughout the summer and fall. Very little of this red canopy was left by spring.

Fuels treatments along roads 46, 4660 and 6230, and pivotal areas on Hamner Butte and Davis Mountain would reduce ladder fuels resulting in reduced fire risks to the remaining habitat. Because it treats just small material ≤12 inches dbh for dead and/or ≤ 9 inches dbh of green, it would not allow for reintroduction of fire in the future

Table 3.64 NRF in Fuels Units

Fuels Unit	Total NRF
40	3
151	6
331	20
70	4
50	3
370	18
55	3
390	15
Total Acres	**73**

There are a number of fuel units that have owl habitat (table 3.64). These units are located on the edge of the fire and were partially burned or underburned. The NRF habitat will be left in leave patches in units 40, 151, 79, 50, and 55. Units 331, 370 and 390 contain larger amounts of NRF Habitat, approximately 50 acres in all (approximately 20 of NRF acres of units 390 and 331 are within the CHU). Unit 390 is also within the Saddle Butte Owl Territory. NRF along unit edges would be left out of unit boundaries. Treatment of NRF in these units would be limited to trees below 8"dbh, on a 13 foot or 15 foot spacing depending on density of trees larger than 8". Leave areas will also be incorporated. These thinning treatments were first used in areas of Seven Buttes project with successful retention of NRF characteristics. Since these areas will not have any overstory removal NRF habitat would not be compromised.

Fuel treatments would limit small diameter ladder fuels to small areas, but retain all NRF characteristics. Removal of understory trees may reduce day roosting sites. Sufficient roosting remains in overstory trees and leave areas. Understory reduction may improve hunting opportunities, allowing better access and sight distance to prey. In the long term, the reduction of ladder fuels in these stands would reduce fire intensity, which decreases the potential of losing the larger trees. Surveys would be completed within owl habitat to determine occupancy. Saddle Butte territory was last determined to be active in 1998, based on surveys in 1998, 1999, 2001, 2002, 2003, and 2004.

Harvest and/or fuels treatments do occur within owl territories. Davis Mountain territory was consistently occupied in the past, but because of the severity of the burn throughout the territory it is expected the pair will not return. Saddle Butte was a marginal territory that had not been occupied for some time. It is not expected that a single or pair would establish itself in this territory. The Hamner Butte territory is occupied and the Butte is considered one of several likely areas for the reestablishment of the Davis pair if they survived the fire. Treatments on Hamner Butte are either 1 to 10 acre slivers of major units within the LSR (46 acres) or in the Matrix and part of units 25, 30 (each 26 acres) and fuels unit 380 (11 acres), 36 (5 acres) that are part of a salvage/fuels treatment designed to reduce risks to remaining habitat. There would be no NRF treated in any salvage units; all pockets of green trees would be left untreated within units.

Table 3.65 Acres of Harvest or Fuels Treatments within Owl Territories

Owl Territory	Acres HSV Alts. B & C	Acres HSV Alt. D	Acres HSV Alt. E	Acres Fuels (All Alternatives)
Davis Mountain	1,735	186	580	64
Hamner Butte	79	0	2	19
Saddle Butte	780	27	443	83

To ensure spotted owls are no longer utilizing the project area or are protected while they are, surveys following the USFWS, 6 survey visits in one season protocol, will be completed throughout the project area regardless of burn intensity. Any burned stands found to have nesting owls will be dropped or deferred from salvage until the area is no longer utilized by owls. Harvest activities within ¼ mile of active nests (1 mile for helicopter activity) would not occur during the nesting period March 1 through September 30.

Indirect effects, including alteration of coarse woody debris distribution, may affect levels of prey. Project design and mitigation measures for retaining the largest pieces of down wood at varying densities across the landscape would provide for varying densities of prey at the time stands develop tree densities and canopy structures preferred by these species.

Indirect effects also include the development of habitat over time. Planting regimes for open stands would provide for the reintroduction of a more natural fire regime. This would ensure that Douglas-fir trees providing nesting structure would develop. At 30 years treated stands have an average height of 25 feet and a canopy closure of 27 percent, there would be a mosaic of brush in the understory and patches of dense down wood. At 40 years treated stands would have an average height of 35 feet, diameter of 7 inches and a canopy closure of 39 percent, providing more dispersal habitat and habitat for flying squirrels. Habitat for the bushy-tailed woodrat could be confined to untreated areas. Patterns of dispersal habitat would emerge and be retained at this time, as stands with higher productivity would be larger and denser. Other stands would be considered for thinning or reintroduction of fire to develop large dominate trees across the landscape. At 100 years the treated stands would have an average height of 64 feet, diameter of 14 inches and a canopy cover of 58%, those thinned or burned earlier would potentially have larger diameters, but lower canopy closure.

Table 3.66 Stand Development Over Time with Planting (Ponderosa pine/Douglas-fir)

Year	Height (ft)	Canopy Cover (%)	Diameter (inches)
2036	25	27	none calculated
2046	35	39	7
2106	64	58	14

Included in the planting acreage for each action alternative are 170 acres of riparian planting and 200 acres of lodgepole planting in the key elk area. The Key Elk area would be monitored for two years prior to planting, to determine if sufficient natural regeneration would take place. These actions provide diversity within the flat next to Davis Lake. The lodgepole would have pockets of increased densities of a given age, which could reach dispersal habitat at age 40, at age 100 diameters could reach 11 inches and be susceptible to pine beetle attacks. These large beetles provide a minor source of food for the spotted owl. Hardwoods planted in the riparian area would also provide dispersal habitat in approximately 40 years. Small birds, rodents and insects attracted to hardwoods may provide secondary prey species for the spotted owl.

Implementing underburning after 40 years to keep the stands open would potentially increase average stand diameters and reduce canopy cover. Underburning would be possible in those stands where fuels were reduced with harvest treatments. Down wood densities would vary across the landscape depending on whether the patch was treated or not, and the level of snags left. Diversity of tree densities and stratification of canopies would be developed through various thinning, underburning and non treatment areas. Reintroduction of fire, or fire in areas of treatments would mimic more a more natural fire regime of low intensity frequent fire. Spotted owls have resided in forests having frequent fire intervals and should have adaptive strategies to repeated fires (Bond et al 2002, Franklin 2004). Bond et al (2002) suggests that prescribed burning could be an effective tool in reducing fire risk and restoring forests to natural conditions with minimal short-term impact to owls.

Roads Analysis

The effects of roads on owls and their habitat includes disturbance and fragmentation of habitat. Roads reduce amount of habitat available, reduce areas of habitat to non-habitat by creation of edge habitat.

The Davis LSR assessment provides the management direction for the LSR. It called for management of roads at a minimum level needed for fire protection and administration, with an open road density target of 1 mi/mi². Current road densities in the LSR are at 3.6 mi/mi². After the Davis Fire, an area closure was put into place and only major roads were open for public travel. A Roads Analysis was completed for the project area with recommendation to close and obliterate roads which would eventually reduce densities within the LSR. It also includes opening some roads to develop through routes and allow strategic access. This strategy will be analyzed in a separate document and implemented within 3 to 5 years.

The Hamner Butte territory is the only one known to be active at this time. The actual nest stand is outside the Davis Fire Recovery project area. Future road obliterations, based on recommendations in the Roads Analysis, would reduce fragmentation within the recovering stands.

Alternative A – No Action

Direct and Indirect Effects

This alternative allows for processes to follow natural succession. There would be no removal of wood, no planting of trees, or fuels reduction. Dispersal habitat would not develop in the first 100 years on approximately 9,800 acres in the LSR and 4,000 acres within the matrix that were burned with high and moderate intensity. Connectivity to Hamner and Ringo Butte to other owl territories would remain limited to a route outside the project area. Large portions of the project area would be lodgepole pine with scattered patches of ponderosa pine and Douglas-fir.

Table 3.67 Acres of Stand Replacement Fire by NWFP Allocation (No Treatments)

NWFP Allocation	Acres in Project Area	Acres of Moderate and High Intensity
Administratively Withdrawn (AWD)	1,020	366.97
Late Successional Reserve (LSR)	11,820	9,732.46
Matrix (MAT)	6,425	3,997.71
Total	19,265	14,097.14

Table 3.68 Dispersal Habitat in Moderate and High Intensity Area Over Time (No Treatments)

Year	PP Total LSR/Matrix	MC Total LSR/Matrix	LP
2036	0	0	0
2046	0 0/0	0 0/0	0
2106	0 0/0	0 0/0	0

Initially, snag habitat would be abundant throughout the area, with 30% of the mixed conifer exceeding 60 snags per acre. These densities would provide habitat for a number of secondary prey species such as voles and woodrats, but not for the northern flying squirrel as canopy cover would be insufficient. At 40 years standing snag levels have dropped and densities range from 0 – 12 snags per acre. The majority of snags densities fall into 0-6 snags per acre. Snag levels do not mimic historic distributions as displayed from DecAID (shaded in following table) where there is a broader distribution of snag densities.

Table 3.69 Snag Habitat over Time, Mixed Conifer – Alternative A

Data From DecAid	MC_D_L unharvested plots		*Post Treatment 2006*		*2046*	
snag density/ha (acre)	≥ 10" dbh % of area	≥ 20" dbh % of area	≥ 10" dbh % of area	≥ 20" dbh % of area	≥ 10" dbh % of area	≥ 20" dbh % of area
0	22%	32%	**1%**	**9%**	**1%**	**9%**
0-15 (0-6)	32%	41%	**10%**	**35%**	**98%**	**84%**
15-30.(6-12)	15%	22%	**2%**	**7%**	**1%**	**7%**
30-45.(12-18)	12%	2%	**6%**	**9%**	**0%**	**0%**
45-60.(18-24)	5%	2%	**1%**	**14%**	**0%**	**0%**
60-75(24-30)	6%		**13%**	**18%**	**0%**	**0%**
75-90(30-36)	5%		**11%**	**4%**	**0%**	**0%**
90-105(36-42)	2%		**10%**	**4%**	**0%**	**0%**
105-120(42-48)	0%		**7%**	**0%**	**0%**	**0%**
120-135(48-54)	0%		**2%**	**0%**	**0%**	**0%**
135-150(54-60)	0%		**7%**	**0%**	**0%**	**0%**
>150 (60)	0%		**30%**	**0%**	**0%**	**0%**
	99%	99%	**100%**	**100%**	**100%**	**100%**

At 40 years down wood habitat would meet or exceed LSR Assessment recommendations of 10 to 35 tons per acre (1.9 – 6.7% down wood cover). It would be abundant and potentially persistent until dispersal habitat develops, unless fire returns to the area. Fire could be introduced into 4,230 acres of stands with fuel loadings between 10 – 35 tons per acre. The remaining area would have fuel loadings range from 60 – 90 tons per acre (11-17% cover). These heavy fuel loads would result in stand replacement fire if fire were to start (see Fire/Fuels section).

At 100 years there are indications that there would be few remaining snags over 20" and no recruitment of large snags in areas of the burn where there was 100% mortality. Sizes of snags being recruited at this time are 9 inches dbh.

Alternatives B and C

Direct and Indirect Effects

Snag reduction would occur on 6,252 acres within the range of the spotted owl. Tree planting would occur within harvest units as well as an additional 2,016 acres of plantations that were burned in the fire. Approximately 57% of the area within the spotted owl range would remain untreated. These actions would have no direct effect on northern spotted owl, as it takes place outside owl habitat, and disturbance mitigation measures are in place.

Table 3.70 Treatments by Northwest Forest Plan Allocation under Alternatives B and C

NWFP Allocation	HSV	Additional Planting	Total Treated	% Treated	% Moderate and High Intensity Treated	Untreated	% Untreated	% Moderate and High Intensity Untreated
AWD	68	35	103	10%	28%	917	90%	72%
LSR	5087	1395	6482	55%	67%	5338	45%	33%
MAT	1097	535	1632	25%	41%	4793	75%	59%
Grand Total	6252	1965	8217	43%	58%	11048	57%	42%

Approximately 1,120 acres of fuels treatments along roads 46, 4660 and 6230, and pivotal areas on Hamner Butte and Davis Mountain would reduce ladder fuels resulting in reduced fire risks to the remaining habitat. Because it treats just small material ≤12 inches dbh for dead and/or ≤ 9 inches dbh of green, it would not necessarily allow for reintroduction of fire in the future.

An indirect effect is development of habitat over time for the owl and its primary prey the northern flying squirrel. Forty years after treatment approximately 1,771 acres in mixed conifer and 404 in ponderosa pine managed areas would provide dispersal habitat.

Table 3.71 Dispersal Habitat in Moderate and High Intensity

Year	PP total LSR/Matrix	MC total LSR/Matrix	LP
2036	0	0	0
2046	404 0 / 404	1771 1,258 / 513	0
2106	1461 1,057 / 404	4506 3,617 / 689	0

Over time the 8,270 treated acres would develop into habitat sooner than non-treated acres providing a range of dispersal, foraging, roosting and ultimately nesting habitat over 58% of the project area within the owl range.

Snag habitat would still be abundant throughout the area, although at a much reduced level compared with Alternative A. Approximately 7% of the mixed conifer habitat would exceed 60 snags per acre, 40% over 30 snags per acre. These densities would provide habitat for a number of secondary prey species, including the northern flying squirrel as canopy cover between 30 and 40 years out would meet the squirrel's preference. At 40 years snag distribution shows a similar decline as Alternative A where the majority of acres are at densities between 0-12 snags per acre. The majority of snags densities fall into 0-6 snags per acre. Snag levels do not mimic historic distributions as displayed from DecAID (shaded in following table) where there is a broader distribution of snag densities.

Table 3.72 Snag Habitat over time – Alternative B and C (LSR, Mixed Conifer)

Data From DecAid	MC_D_L unharvested plots		***Post Treatment 2006***		***2046***	
snag density/ha (acre)	≥ 10" dbh % of area	≥ 20" dbh % of area	≥ 10" dbh % of area	≥ 20" dbh % of area	≥ 10" dbh % of area	≥ 20" dbh % of area
0	22%	32%	**1%**	**9%**	**1%**	**9%**
0-15 (0-6)	32%	41%	**11%**	**56%**	**98%**	**91%**
15-30.(6-12)	15%	22%	**4%**	**23%**	**1%**	**0%**
30-45.(12-18)	12%	2%	**19%**	**9%**	**0%**	**0%**
45-60.(18-24)	5%	2%	**8%**	**2%**	**0%**	**0%**
60-75(24-30)	6%		**20%**	**1%**	**0%**	**0%**
75-90(30-36)	5%		**18%**	**0%**	**0%**	**0%**
90-105(36-42)	2%		**8%**	**0%**	**0%**	**0%**
105-120(42-48)	0%		**1%**	**0%**	**0%**	**0%**
120-135(48-54)	0%		**2%**	**0%**	**0%**	**0%**
135-150(54-60)	0%		**1%**	**0%**	**0%**	**0%**
>150 (60)	0%		**7%**	**0%**	**0%**	**0%**
	99%	99%	**100%**	**100%**	**100%**	**100%**

At 40 years down wood habitat would meet or exceed LSRA recommendations of 10 to 35 tons per acre (1.9 – 6.7% down wood cover). It would be abundant and potentially persistent until dispersal habitat develops, unless fire returns to the area. Fire could be introduced into 10,649 acres in Alternative B and 10,453 in Alternative C of stands with fuel loadings between 10-35 tons per acre. The remaining area would have fuel loadings ranging from 60 -90 tons per acre (11-17% cover). These heavy fuels would result in stand replacement fire if fire were to start.

AT 100 years there would be few fire-killed snags over 20" remaining. There would be recruitment of snags 12 to 16 inches dbh. Use of fire to maintain stands between ages 40-60 years would increase average stand diameter to be larger than the 14 inches the model shows. This would also mean that snag recruitment would be lower than the model shows.

Alternative D

Direct and Indirect Effects

Removal of snags would occur on 943 acres within the range of the spotted owl. Tree planting would occur within harvest units as well as an additional 905 acres. Approximately 90% of the area within the spotted owl range would remain untreated. These actions would have no direct effect on northern spotted owl, as it takes place outside owl habitat, and disturbance mitigation measures are in place.

Table 3.73 Alternative D Treatments within Northwest Forest Plan Allocations

NWFP Allocation	HSV	Additional Planting	Total Treated	% Treated	% Moderate and High intensity Treated	Untreated	% Untreated	% Moderate and High intensity Untreated
AWD	0	35	35	3%	10%	985	97%	90%
LSR	0	335	335	3%	3%	11485	97%	97%
MAT	943	535	1478	23%	37%	4947	77%	63%
Grand Total	**943**	**905**	**1848**	**10%**	**13%**	**17417**	**90%**	**87%**
CHU	13	210	223	3%	3%	7,069	97%	97%

Indirect effects include development of habitat over time for the owl and its primary prey the northern flying squirrel. Forty years after treatment, approximately 404 acres in ponderosa pine-managed areas would provide dispersal habitat. This habitat would be entirely in the Matrix. There would be very little habitat development in the LSR/CHU.

Table 3.74 Dispersal Habitat in Moderate and High Intensity

Year	PP total LSR/Matrix	MC total LSR/Matrix	LP
2036	0	0	0
2046	404 0/404	60 0/60	0
2106	1461 1057/404	150 30/120	0

Over time the 1,848 treated acres would develop into habitat sooner than non-treated acres providing a range of dispersal, foraging, roosting and ultimately nesting habitat over 10% of the project area within the owl range, 2% of the LSR. This could lead to non-occupancy of the Hamner and Ringo owl territories when current resident owls die, due to insufficient dispersal habitat, as well greatly delay habitat development on Davis Mountain and Saddle Butte.

Approximately 1,450 acres of fuels treatments along roads 46, 4660 and 6230, and pivotal areas on Hamner Butte and Davis Mountain would reduce ladder fuels resulting in reduced fire risks to the remaining habitat. Because it treats just small material ≤12 inches dbh for dead and/or ≤ 9 inches dbh of green, it would not allow for reintroduction of fire in the future when stands become established.

Snag habitat would still be abundant. With no treatment within the LSR, effects would be the same as Alternative A, little to no large snag recruitment even at 100 years out. Snag levels do not mimic historic distributions as displayed from DecAID (shaded in following table) where there is a broader distribution of snag densities.

Table 3.75 Snag Habitat over Time – Alternative D

Data From DecAid	MC_D_L unharvested plots		*Post Treatment 2006*		*2046*	
snag density/ha (acre)	≥ 10" dbh % of area	≥ 20" dbh % of area	≥ 10" dbh % of area	≥ 20" dbh % of area	≥ 10" dbh % of area	≥ 20" dbh % of area
0	22%	32%	**1%**	**9%**	**1%**	**9%**
0-15 (0-6)	32%	41%	**11%**	**37%**	**98%**	**85%**
15-30.(6-12)	15%	22%	**3%**	**10%**	**1%**	**6%**
30-45.(12-18)	12%	2%	**6%**	**10%**	**0%**	**0%**
45-60.(18-24)	5%	2%	**1%**	**11%**	**0%**	**0%**
60-75(24-30)	6%		**17%**	**17%**	**0%**	**0%**
75-90(30-36)	5%		**11%**	**4%**	**0%**	**0%**
90-105(36-42)	2%		**10%**	**2%**	**0%**	**0%**
105-120(42-48)	0%		**7%**	**0%**	**0%**	**0%**
120-135(48-54)	0%		**2%**	**0%**	**0%**	**0%**
135-150(54-60)	0%		**3%**	**0%**	**0%**	**0%**
>150 (60)	0%		**28%**	**0%**	**0%**	**0%**
	99%	99%	**100%**	**100%**	**100%**	**100%**

At 40 years down wood habitat would meet or exceed LSRA recommendations of 10 to 35 tons per acre (1.9-6.7% down wood cover). It would be abundant and potentially persistent until dispersal habitat develops, unless fire returns to the area. Fire could be introduced into 6.906 acres of stands with fuel loadings between 10-35 tons per acre. The remaining area would have fuel loadings range from 60-90 tons per acre (11-17% cover). These heavy fuel loads would result in stand replacement fire if fire were to start (refer to Fire/Fuels section).

Alternative E

Direct and Indirect Effects

Reduction of snags would occur on 3,440 acres within the range of the spotted owl. Tree planting would occur within harvest units as well as an additional 725 acres. Approximately 78% of the area within the spotted owl range would remain untreated. These actions would have no direct effect on northern spotted owl, as it takes place outside owl habitat, and disturbance mitigation measures are in place.

Table 3.76 Treatments by Northwest Forest Plan Allocations Under Alternative E

NWFP Allocation	HSV	Additional Planting	Total Treated	% Treated	% Moderate and High Intensity Treated	Untreated	% Untreated	% Moderate and High Intensity Untreated
AWD	68	35	103	10%	28%	917	90%	72%
LSR	2,765	540	3,305	28%	34%	8,515	72%	66%
MAT	607	150	757	12%	19%	5,668	88%	81%
Grand Total	**3,440**	**725**	**4,165**	**22%**	**30%**	**15,100**	**78%**	**70%**

Approximately 1,120 acres of fuels treatments along roads 46, 4660, and 6230, and pivotal areas on Hamner Butte and Davis Mountain would reduce ladder fuels resulting in reduced fire risks to the remaining habitat. Because it treats just small material ≤12 inches dbh for dead and/or ≤ 9 inches dbh of green, it would not necessarily allow for reintroduction of fire in the future.

Indirect effects include development of habitat over time for the owl and its primary prey the northern flying squirrel. Forty years after treatment approximately 900 acres in mixed conifer and 200 acres in ponderosa pine managed areas would provide dispersal habitat.

Table 3.77 Dispersal Habitat in Moderate and High Intensity Alternatives E

Year	PP total LSR/Matrix	MC total LSR/Matrix	LP
2036	0	0	0
2046	200 0/200	900 600/300	0
2106	750	2,300	0
	650/300	2,000/300	

Over time the 4,165 treated acres would develop into habitat sooner than untreated acres providing a range of dispersal, foraging, roosting and ultimately nesting habitat over 58% of the project area within the owl range.

Under Alternative E, snag habitat would still be abundant throughout the area, although at a much reduced level compared with Alternative A. Approximately 16% of the mixed conifer habitat would exceed 60 snags per acre. These densities would provide habitat for a number of secondary prey species, including the northern flying squirrel, as canopy cover would meet the squirrel's preference in 30 to 40 years. At 40 years snag distribution shows a similar decline as Alternative B and C where the majority of acres are at densities between 0-12 snags per acre. The majority of snags densities fall into 0-6 snags per acre. While it indicates there are fewer areas with higher densities, there are also fewer acres with no snags. At 100 years there would be few fire-killed snags over 20" remaining. There would be recruitment of snags 12 to 16 inches dbh. Use of fire to maintain stands between ages 40-60 years, would increase average stand diameter to be larger than the 14 inches the model shows. This would also mean that snag recruitment would be lower than the model shows.

Table 3.78 Snag Habitat Over Time – Alternative E

Data From DecAid	MC_D_L unharvested plots		Post Harvest 2006		2046	
snag density/ha (acre)	≥ 10" dbh % of area	≥ 20" dbh % of area	≥ 10" dbh % of area	≥ 20" dbh % of area	≥ 10" dbh % of area	≥ 20" dbh % of area
0	22%	32%	1%	9%	1%	9%
0-15 (0-6)	32%	41%	11%	48%	98%	87%
15-30.(6-12)	15%	22%	1%	14%	1%	4%
30-45.(12-18)	12%	2%	12%	11%	0%	0%
45-60.(18-24)	5%	2%	7%	6%	0%	0%
60-75(24-30)	6%		15%	8%	0%	0%
75-90(30-36)	5%		18%	0%	0%	0%
90-105(36-42)	2%		8%	4%	0%	0%
105-120(42-48)	0%		6%	0%	0%	0%
120-135(48-54)	0%		0%	0%	0%	0%
135-150(54-60)	0%		5%	0%	0%	0%
>150 (60)	0%		16%	0%	0%	0%
	99%	99%	100%	100%	100%	100%

At 40 years down wood habitat would meet or exceed LSRA recommendations of 10 to 35 tons per acre (1.9-6.7% down wood cover). It would be abundant and potentially persistent until dispersal habitat develops, unless fire returns to the area. Fire could be introduced into 8,045 acres of stands with fuel loadings between 10 -35 tons per acre. The remaining area would have fuel loadings range from 60-90 tons per acre (11-17% cover). These heavy fuel loads would result in stand replacement fire if fire were to start (refer to Fire/Fuels section for more info on predicted fuel levels).

Cumulative Effects

Planning Area

The Davis fire reduced nesting, roosting, and foraging (NRF) habitat within the project area by approximately 5,000 acres, suppression efforts (e.g. burnout operations) account for 450 of those acres. Reduction of habitat by construction and rehabilitation of firelines, handline and tractor, was minimal and included in the total acres of suppression habitat loss.

Table 3.79 NRF Distribution Across Davis Fire Recovery Project Area Before and After Davis Fire

NWFP Allocation	Pre-Fire NRF	NRF Lost in Davis Fire	Post-Fire NRF	Degraded NRF
LSR	4,370	3,959	43	368
CHU only*	(3,524)	(3,276)	(29)	(219)
Matrix	1,286	1,108	29	149
AWD	103	71	15	17
TOTAL	**5,759**	**5,138**	**87**	**534**

Nesting, roosting and foraging habitat would still be provided on approximately 600 acres within the fire area. NRF habitat that was underburned (534 acres) may have further mortality that may render it less than suitable habitat. Non-NRF habitat areas that were in the part of the fire where a mosaic of intensities *(left units less than 70% dead)* occurred (4000 acres) would provide some dispersal habitat in the short term. Within the mosaic of intensities 1400 acres *(left units less than 70% dead, mcd pag but not cwh1-11 or cws1-12)* occur within mixed conifer plant associations that could develop into NRF habitat, within a relatively short time (20-75 years) depending on the size of the moderate or high intensity pockets within them and the subsequent level of mortality of understory white fir and lodgepole pine in underburn pockets.

There would be no treatments within the fire boundary other than those proposed with this project in the foreseeable future. Thinning, underburning and other treatments mentioned in this analysis would be proposed, planned and analyzed at the appropriate time.

Vegetation Management Projects areas that over lap with the Davis Fire include Seven Buttes, Seven Buttes Return, and Charlie Brown. Within these projects, no treatment of NRF habitat would occur within spotted owl home ranges. Seven Buttes reduced NRF habitat by 2,700 acres, including approximately 1,500 acres within the Davis Fire boundary. Treatments included upper and lower management zone thinning. Upper management thinnings would maintain the large tree component and multi-story forests characteristics. These treatments are expected to create blocks of more sustainable NFR habitat with tree species such as ponderosa pine and Douglas-fir that are less susceptible to insects and disease outbreaks. These blocks are expected to provide NRF habitat again within several decades and serve as potential nest stands in case new spotted owls move into the Seven Buttes Planning area or where existing spotted owls may re-locate if/when NRF stands within owl territories fall apart from beetle outbreaks or fire. Where single story thinning treatments are proposed, current NRF habitat would be converted to stands providing dispersal capability. The majority of the single story treatments are located within bald eagle management areas where the desire is to greatly reduce stand density and basal area to maintain and enhance eagle nesting habitat. These single story stands are not expected to provide nesting habitat capability for the northern spotted owl in the long-term but would provide adequate dispersal habitat for owls that may move through these stands.

Seven Buttes Return proposed treatments in 3,300 acres of NRF habitat, including 90 acres within the fire boundary. The prescriptions were similar and had the same objectives as Seven Buttes. The proposed

treatments did not take place and will undergo further analysis due to the fire. There would be no treatments within the fire boundary that would be taken forward.

The Charlie Brown analysis area is on the Bend Fort-Rock Ranger District. It proposes similar vegetative and fuels treatments described for Seven Buttes. Some of these treatments would occur in the Browns and Wickiup subwatersheds which overlap with the Crescent Ranger District. There were 8,796 acres of NRF habitat identified in the Charlie Brown project area and the preferred alternative would impact 990 acres of NRF habitat of which, approximately 587 acres of NRF treatment would occur within the Browns LSR. The U.S. Fish and Wildlife Service consulted on the Charlie Brown project and concurred with the effects determination for the northern spotted owl. Habitat removal was authorized for 990 acres of northern spotted owl NRF habitat.

There are several thousand acres of private lands in the PA primarily east of Odell Butte and easterly towards U.S. Highway 97. Most of the lands are owned by the Crown Pacific Corporation, a private timberland company. None of the private land acreage currently provides NRF habitat. Because of rotation schedules and forest capabilities, it is unreasonable to assume NRF stands would be provided in private lands. Some of the stands however, currently provide dispersal habitat through lodgepole pine and/or ponderosa pine forests although timber harvest operations are continually in operation. In the short- and long-term, some portion of private timberlands may function as dispersal habitat depending on harvest rotations and silvicultural prescriptions.

Other commercial activities that occur within the planning area include harvest of mushrooms that typically come in after a fire, such as morels. These mushrooms are generally associated with upland habitats. While there would be more activity the first two years following the fire, the activity is expected to focus on areas where there was 100% mortality. Removal of morels would not impact potential prey of the spotted owl. Saab and Dudley (1998) found squirrels did not return to burn areas for 3 years post burn. Fire-influenced mushroom growth only lasts for 2 years.

Treatment of noxious weed is an ongoing project along major roads within the planning area. Spot treatments (less than an acre) include manual, mechanical removal of weeds, as well as chemical treatments with the herbicide Dicamba. Dicamba is a benzoate auxin herbicide that mimicks a plant hormone in broadleaf plants (Syracuse Environmental Research Associates, Inc.: www.sera-inc.msn.com). It causes a hormone imbalance resulting in abnormal growth in the plant to a degree that the plant life processes no longer work and the plant dies. The hormonal imbalance is specific to plants. Studies on toxicity to animals have found at high doses (above recommended application levels), the chemical can cause skin and eye irritations (same reference). It does not bioaccumulate. Treatments would have no effect on northern spotted owls.

Recreation and campground improvements would have no effect on spotted owls. The campgrounds and most recreation are focused around Davis Lake. Campgrounds do not contain habitat. There currently is no recreational activity or improvement planned that would take place within NRF habitat.

Crescent Ranger District

Across the Crescent Ranger District there are several proposed and ongoing projects that reduce NRF habitat. The Baja 58 project reduced NRF habitat on 1,068 acres, including 90 within the Crescent LSR. The objectives for the understory thinning in this project area, similar to Seven Buttes, maintain the large tree component in single and multi-storied structure. Crescent Lake WUI (wildland urban interface) project is awaiting a decision. The project reduces fuel loadings adjacent to the community of Crescent Lake as well as high use campgrounds, resorts and a Boy Scout camp. Within the proposal is treatment of 162 acres of NRF habitat, 52 acres within Davis LSR. This project is on the western end of the LSR. The U.S. Fish and Wildlife Service consulted on the project and concurred with the effects determination for the northern spotted owl. Habitat removal was authorized for 162 acres of NRF habitat.

Deschutes National Forest

Fires and timber harvest have reduced owl habitat across the forest. In the past four years, NRF on the Forest has been reduced by timber harvest (approximately 10,000 acres) or wildfires (1,400 acres). Appendix A from the programmatic Biological Assessment was updated January 2004 to reflect the changes due to the large fires

on the Crescent and Sisters Ranger district (USFS 2004). The following table includes losses of habitat by the Davis Fire.

Table 3.80 Changes in Spotted Owl Baseline Habitat

Ranger District	2003 Baseline	NRF Lost	NRF Lost	Removal	January 2004 Baseline
	(App B)	Mod-High Intensity Fire	Low Intensity Fire	<2ac slivers Fire Caused	(App B)
Crescent	34,008	-5,081		-73	**28,854**
Sisters	51,936	-6,644	-4,458	-548	**40,286**
Bend-Ft Rock	24,791				**24,791**
Forest Total	110,735	-11,725	-4,458	-621	**93,931**

Over the last two years, fire has reduced the amount of NRF within owl home ranges. This year alone, between the Davis Fire and the B and B fire on Sisters Ranger District NRF was reduced in 16 home ranges. It is questionable if 15 of those areas would support spotted owls. Because of the low density of owls on the Deschutes National Forest those remaining home ranges become very important to the persistence of owls on the forest.

Determination

The Odell Watershed assessment and Davis LSR Assessment identified that most of the watershed and LSR was at risk for insect disease and fire due to the in-growth of shade tolerant species. The fire resulted in higher intensities than normal. Fuel loadings as a result are also higher than normal, and it would take several fire cycles to correct this if left without treatment.

The loss of owl habitat on the district has been limited over the years to timber harvest. Recent harvest is aimed at blocking up habitat, understory thinning to maintain the large tree component on the landscape, and place owl habitat on various successional tracks.

There are limited plant associations that can produce NRF habitat. Davis Mountain/Hamner Butte area is one of the major locations for large blocks of these plant associations. The Davis Mountain/Hamner Butte area provides connectivity to LSRs to the north and south.

Alternatives A and D do not provide for the development of habitat. Alternative A does not provide for the reduction of fuels to allow for the reintroduction of fire. Alternative D does planting treatments on 3% of the LSR, and salvage of 37% of the 100% Matrix allowing for some habitat development under a fire regime. Because of minimal or total lack of habitat development within the LSR for 100-150 years, continued occupation of Hamner Butte and Ringo Butte home ranges are at risk due to insufficient dispersal habitat**. Alternatives A and D may affect likely to adversely effect the northern spotted owl.**

Alternatives B, C, and E provide for large area fuels reduction through salvage to allow for future reintroduction of fire across major portions of the planning area. The fuels reduction in addition to planting tree species that are compatible with the historic fire regime would provide and maintain large trees over the long term. Planting of trees should provide dispersal habitat within 30-40 years. In the long term Alternatives B, C and E would be beneficial to the northern spotted owl.

There would be **no effect** to the northern spotted owl with the salvage of dead trees in areas with 100% mortality, or the associated actions of salvage unit fuels treatments, reforestation, or temporary road building in Alternatives B, C, and E. Treatment units are not providing NRF habitat or dispersal habitat. Surveys consisting of 6 visits will be completed to protocol in 2004. Surveys complete to date (as of June 30, 2004) did not confirm

any spotted owl use occurring within the fire perimeter. Mitigation measures ensure active sites are protected and disturbance is minimized.

Fuels treatments in 53 acres of NRF will reduce small diameter trees, opening up the understory. Treatments consist of thinning the understory of trees ≤ 8" dbh. In addition to roosting habitat provided by the overstory and trees over 8" dbh, clumps of untreated areas would be left scattered across the NRF portions of the unit. Within all units all characteristics of NRF, nesting, roosting, and foraging are maintained. While overall roosting opportunities may be reduced by opening up the understory, foraging opportunities are increased. Over the long term, the fuels treatments would reduce fire intensity and minimize the loss of large trees within the stand, increasing longevity of the remaining large tree habitat for nesting. It is expected that these treatments would reoccur on a 10-15 year cycle to maintain the benefits of a reduction in ladder fuels. Therefore, the fuels treatments in Alternatives B, C, D, and E **may affect not likely to adversely effect northern spotted owls.**

Of the 20 acres impacted by fuels treatments within the CHU, 15 acres occur within the Saddle Butte territory. There would be no effect to northern spotted owls with treatment within this territory. Originally the territory had 35 percent of the home range in NRF habitat. The fire reduced 142 acres of NRF habitat leaving only 9 percent of the home range in NRF habitat. In addition, the Saddle Butte territory was last determined to be active in 1998.

Critical Habitat CHU-OR7

Critical Habitat Units (CHUs) were developed by USFWS as a network of habitat to support continued persistence of the Northern Spotted Owls. CHUs were established prior to the signing of the NWFP and the designation of LSRs. As with LSRs, maintenance of habitat within CHUs is important. Approximately 20 of the 53 acres of NRF fuel treatments occur within the CHU. As previously mentioned, over all roosting opportunities may be reduced by opening up the understory, foraging opportunities are increased. Over the long term the fuels treatments would reduce fire intensity and minimize the loss of large trees within the stand, increasing longevity of the remaining large tree habitat for nesting. Because of the reduction in roosting opportunities, implementation of Alternatives B, C, D, or E fuels treatments **may affect not likely to adversely effect northern spotted owl critical habitat.**

While there is no development of habitat with Alternative A, there is also no reduction of quality in existing NRF. Implementation of Alternative A would have **no effect on northern spotted owl critical habitat.**

Regional Forester's Sensitive Species

Species classified as sensitive by the Forest Service are to be considered through the National Environmental Policy Act process by conducting biological evaluations (BE) to determine potential effects of all programs and activities on these species (FSM 2670.32). The BE is a documented review of Forest Service activities in sufficient detail to determine how a proposed action may affect sensitive wildlife species, and to comply with the requirements of the Endangered Species Act.

The 2000 Forest Service Region 6 Sensitive Animal list was reviewed for species that may be present on the Deschutes National Forest. After a review of records, habitat requirements, and existing habitat components, it was determined that the following sensitive animal species have habitat or are known to occur in the project area and will be included in this analysis (table 3.108):

Oregon spotted frog (*Rana pretiosa*)
Red necked grebe *(Podiceps grisegena)*
Tricolor blackbird (*Agelaius tricolor*)
Pacific fisher *(Martes pennanti)*
Horned grebe *(Podiceps auritus)*
Bufflehead duck *(Bucephala albeola)*
California wolverine (*Gulo gulo leuteus)*
American peregrine falcon (*Falco peregrinus anatum*)

Table 3.81 Sensitive Species Summary

Species	Status	Habitat	Presence
Oregon spotted frog (*Rana pretiosa)*	Federal Candidate, Regional Forester Sensitive	Stream, Marsh	Documented
Bufflehead duck *(Bucephala albeola)*	Regional Forester Sensitive	Lake, snags	Sighting
Harlequin duck *(Histrionicus histrionicus)*	Regional Forester Sensitive	Rapid Streams, Large trees	No habitat
Horned grebe *(Podiceps auritus)*	Regional Forester Sensitive	Lake	Unknown
Pacific fisher *(Martes pennanti)*	Regional Forester Sensitive	Mixed, Complex	Sighting
Pygmy rabbit *(Brachylagus idahoensis)*	Regional Forester Sensitive	Sagebrush flats	No habitat
Red-necked grebe *(Podiceps grisegena)*	Regional Forester Sensitive	Lake	Unknown
Tricolored blackbird *(Agelaius tricolor)*	Regional Forester Sensitive	Lakeside, Bulrush	Unknown
Gray flycatcher *(Empidonaz wrightii)*	Regional Forester Sensitive	Ponderosa pine w/ sagebrush or bitterbrush	No habitat
Western sage grouse *(Centrocercus urophasianus phaeios)*	Regional Forester Sensitive	Sagebrush flats	No habitat
Yellow rail *(Coturnicops noveboracensis)*	Regional Forester Sensitive	Marsh	Unknown
California wolverine *(Gulo gulo)*	Regional Forester Sensitive, MIS	Mix, High elevation	Sighting
American peregrine Falcon *(Falco peregrinus anatum)*	Regional Forester Sensitive, MIS	Riparian, Cliffs	Sighting

After a review of records, habitat requirements, and existing habitat components, it was also determined that the remaining sensitive species do not occur and have no habitat in the project area and will not be included in any further analysis: Yellow rail (*Coturnicops noveboracensis*), Harlequin duck *(Histrionicus histrionicus*), Gray flycatcher (*Empidonax Wrightii*), Pygmy rabbit (*Brachylagus idahoensis*) and the Western sage grouse *(Centrocercus urophasianus phaios).*

Yellow rail breeding takes place in emergent wetlands, grass or sedge and wet meadows in freshwater situations. Some breeding territories in these wet meadows contain firm footing and only a few remnant pools of water. From information gathered over the last six years, nest habitat of the yellow rail in Oregon has been described as marshes or wet meadows which have an abundance of thin-leaved sedges, a layer of senescent vegetation to conceal their nests, and an average water depth of 7 cm. (Popper 2001). While marsh habitat is associated with

the margin of Davis Lake, it is not sufficient in size, vegetation or consistent enough in water depth to provide habitat for the yellow rail. Implementation of any of the alternatives would have **no impact** on yellow rail.

Harlequin ducks winter in rough coastal waters, especially along rocky shores or reefs; summering nonbreeders also occur in this habitat. Harlequins nest along fast-moving rivers and mountain streams on rocks or banks. (NatureServe 2003). On the Crescent District, Trapper Creek and the upper Little Deschutes River canyon may be the most suitable potential breeding habitat available. Habitat for the harlequin duck does not occur within the project area. Implementation of any of the alternatives would have **no impact** on harlequin ducks.

Gray flycatchers in northern Washington use fairly specific habitat: dry open ponderosa pine stands with extensive bitterbrush and bunchgrasses. In central Oregon, they are commonly found in juniper, sage, bunchgrass habitat. The common factor seems to be scattered vertical structure of evergreen trees over an extensive shrub and grass understory (savannah). Although no surveys have been completed for this species on the Crescent RD, and there are no recorded sightings in the wildlife observations database, it may be possible that the gray flycatcher is on the District. Gray flycatchers have been documented during the breeding season on the Chemult Ranger District of the Fremont-Winema National Forest only 20 miles south of Crescent. They were found in ponderosa pine/lodgepole pine plantations that had been pre-commercially thinned, generally more open than the surrounding forested areas and with abundant bitterbrush. Habitat for gray flycatcher occurs on the east side of the District; it does not occur within the project area. Implementation of any of the alternatives would have **no impact** on the gray flycatcher.

Pygmy rabbits typically occur in dense stands of big sagebrush growing in deep loose soils (NatureServe 2003). This habitat type does not occur within the project area. Implementation of any of the alternatives would have **no impact** on pygmy rabbit.

Western sage grouse are found in foothills, plains, and mountain slopes where sagebrush is present and the habitat contains a mixture of sagebrush, meadows, and aspen in close proximity. Winter habitat (palatable sagebrush) probably is the most limited seasonal habitat in some areas (NatureServe 2003). This habitat type does not occur within the project area. Implementation of any of the alternatives would have **no impact** on western sage grouse.

Table 3.82 Summary of Conclusion of Effects, Pacific Northwest Region Sensitive Species

	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Oregon spotted frog (*Rana pretiosa*)	NI	NI	NI	NI	NI
Horned grebe *(Podiceps auritus)*	NI	NI	NI	NI	NI
Rednecked grebe *(Podiceps grisegena)*	NI	NI	NI	NI	NI
Bufflehead duck *(Bucephala albeola)*	NI	MIHH	MIHH	MIHH	MIHH
Harlequin duck *(Histrionicus histrionicus*)	NI	NI	NI	NI	NI
American peregrine falcon (*Falco peregrinus anatum*)	NI	NI	NI	NI	NI
Western sage grouse *(Centrocercus urophasianus phaios*)	NI	NI	NI	NI	NI
Yellow rail (*Coturnicops noveboracensis*)	NI	NI	NI	NI	NI
Tricolor blackbird (*Agelaius tricolor*)	NI	NI	NI	NI	NI
Gray flycatcher (*Empidonaz wrightii*)	NI	NI	NI	NI	NI
California wolverine (*Gulo gulo*)	NI	NI	NI	NI	NI
Pacific fisher *(Martes pennanti)*	NI	NI	NI	NI	NI
Pygmy rabbit (*Brachylagus idahoensis*)	NI	NI	NI	NI	NI

NI = No Impact
MIIH = May impact individuals or habitat, but will not likely contribute to a trend toward federal listing or loss of viability to the population or species
BI = Beneficial Impact

Oregon Spotted Frog, *Federal candidate and Region 6 Sensitive*

Existing Conditions

The Oregon spotted frog (*Rana pretiosa*) is currently listed as a candidate species by USFWS. Spotted frogs have a historic distribution that covers a small part of western North America, from southern British Columbia to northeastern California, and from the west side of the Willamette Valley to the east side of the Oregon Klamath basin. They have been extirpated in much of their range by introduction of the bullfrog (*Rana catesbeiana*), and habitat alteration and loss through intensified agriculture, grazing, and urbanization (USGS 2003).

Oregon spotted frogs are marsh specialists tied to permanent water in marsh type habitats with lots of floating vegetation and good hiding areas. Oviposition usually occurs between mid-February to mid-April, depending on temperature. Egg masses are typically deposited communally, attached to vegetation in shallow water (Hayes et al 1997). Often found in the flooded upland adjacent to permanent water, the diet of the spotted frog consists mainly of insect material including moths, water striders, hoverflies, grasshoppers, spiders, beetles, and caddis flies.

Based on surveys conducted in 1994 (Hayes 1995), there are currently six known populations of Oregon spotted frogs on the Crescent Ranger District: Davis Lake at the mouth of Ranger Creek, Davis Lake near the mouth of Odell Creek, Odell Creek ford at Road 4660, Big Marsh, and two locations along the Little Deschutes River. Two spotted frogs were found in Ranger Creek, ten in Odell Creek, and about 300 spotted frogs in Big Marsh. Extensive surveys have only been conducted at Big Marsh. The 2003 egg mass surveys documented over 700 egg masses there. Hayes (1995) stated spotted frog habitat was limited in Ranger and Odell Creeks because brook trout were present, stream temperatures were cold, and side channels were limited that offer warm, shallow water habitat needed by the frogs.

Post-Fire

The fire burned with varying intensities along both Ranger Creek and Odell creek. In-stream habitat for the Oregon spotted frog was unaffected. Reduction of overstory could lead to more grasses and sedges in the flood plain creating additional breeding sites in the early spring.

Environmental Consequences

All Alternatives

Direct and Indirect Effects

There is no removal of standing or down wood within the riparian areas or buffers with any of the alternatives. Dead trees falling into the stream could create debris dams, pooling and additional habitat for the spotted frog.

Decadent willow, alder and other riparian species are already resprouting along Odell and Ranger Creeks. These species are typically fast growing, especially in the absence of the now burned overstory of lodgepole pine. These plants should be providing shade to these bodies of water within five years. Supplemental planting of willow and alder proposed in the action alternatives could decrease the establishment time, and delay encroachment of lodgepole pine. Re-establishment of hardwoods shrubs along the streams either naturally (alternative A) or by planting (all action alternatives) streams would add diversity to the landscape and could result in beavers returning to the area. Pools and trenches created by beaver dams would provide habitat for spotted frogs.

Cumulative Effects

A log placement project scheduled for the summer of 2004 on the lower 1.5 miles of Odell Creek would increase shallow water habitat for spotted frogs as well as hiding structure. Approximately 150 logs will be placed in logjam structures. If additional instream large wood placement projects are implemented in Reaches 2 and 3 of Odell Creek additional frog habitat would be made as a result of increased floodplain connectivity.

Determination

There are no actions proposed that would cause alteration of habitat or disturbance to these species. There would be **no effect** upon the Oregon spotted frog with the implementation of any of the alternatives.

Horned Grebe, Redneck Grebe, *R6 Sensitive*

Existing Conditions

Horned grebes utilize marshes, ponds, lakes, and occasionally along sluggish moving streams for breeding. They nest among tall vegetation in shallow water on small and large lakes and ponds (about 0.1 ha or larger), in calm waters of marshes, along rivers and streams. The highest breeding densities occur in pothole marshes of aspen woodland. Outside the breeding season horned grebes are found on bays, estuaries and seacoasts, and in migration commonly in inland freshwater habitats, especially lakes and rivers (NatureServe 2000).

Red-necked grebes winter along seacoasts, bays, and estuaries. During migration they are found on lakes, ponds, and rivers. They nest on lakes, marshes, ponds, or calm rivers, usually in areas with some vegetative cover and favor shallow lakes with good fish populations. The nest is a mound of vegetation, floating or sitting in shallow water, anchored to vegetation, or built on muskrat houses. Red-necked grebes dive under water to forage on or near the bottom. They feed on small fish, where available, but also eat aquatic and terrestrial insects, crustaceans, mollusks, aquatic worms, tadpoles, salamander eggs and some vegetable matter (NatureServe 2000).

There are no known sightings of horned grebes or red-necked grebes on the Crescent Ranger District. There is potential habitat for both grebes at Davis Lake, Big Marsh, Crescent Lake, Wickiup Reservoir and possibly some of the high mountain lakes in the Oregon Cascades Recreation Area (OCRA). Surveys were not conducted for any of these species.

Environmental Consequences

Direct, Indirect and Cumulative Effects

There is no disruption of these species or alteration of their habitat with the implementation of any of the alternatives. Mitigation measures in place for bald eagles ensure helicopter disturbance, if any, occurs outside of the breeding season. Davis Lake was used nearly year round as access permits for fishing, recreation and fall duck hunting. Grebes using this area would have become habituated to these disturbances or gravitate to less used portions of the Lake.

Restoration of East Davis Campground and the plans for expansion of Lava Flow campground to make up for the loss of West Davis Campground, would not necessarily increase recreational use beyond prefire levels.

Determination

There would be **no effect** upon the horned grebe or red-necked grebe with the implementation of any of the alternatives. There are no actions proposed that would cause alteration of habitat or disturbance to these species.

Bufflehead Duck, *R6 Sensitive*

Existing Conditions

Buffleheads utilize lakes, ponds, rivers and seacoasts. The birds nest in natural tree cavities or abandoned flicker holes in mixed coniferous-deciduous woodland near lakes and ponds. Females often nest in the same site in successive years. Buffleheads winter on sheltered bays and estuaries as well as open freshwater situations (NatureServe 2000).

On the Crescent Ranger District, buffleheads are commonly seen on Crescent Lake, Odell Lake, Davis Lake, and Wickiup Reservoir and are likely present on the high mountain lakes in the OCRA.

Environmental Consequences

Direct, Indirect and Cumulative Effects

Alternative A and D would not remove any snags adjacent to the lake. Snags with conditions to provide cavities would develop over time as recently killed snags are infested with bugs and rot allows the formation of cavities by primary cavity excavators. Because of the time it takes for snags to reach conditions favorable for primary excavators, and secondary cavity nesters there would not necessarily be a flush of potential nest sites the first few years, but a gradual increase followed by a gradual decrease as snags fell. Alternatives B, C and E remove some snags adjacent to the lake. Most immediately adjacent would remain. Snags greater than 36 inches dbh would be retained. There would not be a flush of potential nest sites, there would also not be as many snags available to become nests sites. This could limit individuals opportunities for finding suitable nests at Davis Lake and they would have to look to habitat on Odell Lake, Crescent Lake or Wickiup Reservoir.

Determination

While there would be an abundance of snags in all alternatives, however, not every snag would be retained in Alternatives B, C and D potentially reducing nesting opportunities for individual buffleheads. Implementation of Alternatives B, C or D **may impact individuals or habitat, but will not likely contribute to a trend toward federal listing or loss of viability to the population or species.** There would be no snags removed in the vicinity of the lake in Alternatives A and E. Implementation of Alternatives A or E would have **no impact** on the bufflehead duck.

American Peregrine Falcon, *R6 Sensitive and MIS*

Existing Conditions

Peregrine falcon habitat consists of nesting, perching, roosting, and foraging areas. They nest almost exclusively on cliffs, usually near water. Tree nesting is virtually unknown in this population, and nesting on man-made structures is rare. The most preferable nest sites are on sheer cliffs, 150 feet or more in height, with small caves or overhanging ledges large enough to hold 3 to 4 fully grown nestlings. The nestling period ranges from March through July, depending on elevation, aspect, and microclimate of nest cliffs and/or availability of prey. Peregrines are particularly sensitive to disturbance during that time (Pagel 1991). Associated with nesting territory are foraging areas, which include wooded areas, marshes and open grasslands. Peregrines prey almost exclusively on birds. Wooded areas near water attract a variety of potential prey species.

District records list one peregrine falcon sighting on Davis Lake in the fall months. It may have been a migrant passing through to wintering grounds. Potential nesting habitat may be present in the upper Little Deschutes River canyon, Maiden Peak, and in the lava rock complex near Davis Lake. Surveys of these areas have not been completed due to the lack of sightings of peregrines on the District. Davis Lake is monitored yearly for eagles. While prairie falcons have been observed in the area, peregrines have not.

Environmental Consequences

Direct Indirect, and Cumulative Effects

None of the alternatives would alter the use of the area by peregrines. There is no nesting habitat in the project area. Potential nesting habitat in the adjacent lava flow would not be altered by any of the alternatives. Disturbance to potential habitat would not occur with any of the action alternatives. The lava flow is outside any flight path needed to harvest the units.

Determination

Because peregrine habitat would not be altered or disturbed, implementation of any of the alternatives would have **no impact** on peregrine falcons.

Tricolor Blackbird, *R6 Sensitive*

Existing Conditions

Tricolor blackbirds are highly gregarious, roosting and foraging in flocks. They are found in fresh-water marshes of cattails, tule, bulrushes and sedges. During the migration and in winter they can also be found in open cultivated lands and pastures. The tricolor blackbird nests in vegetation of marshes or thickets, sometimes nests on the ground (NatureServe 2000).

Tricolor blackbirds have not been documented on the Crescent Ranger District. Potentially suitable nesting habitat is present along the shoreline of Davis Lake, Big Marsh, and scattered locations along the Little Deschutes River. No surveys have been conducted to confirm species presence.

Environmental Consequences

Direct, Indirect and Cumulative Effects

None of the alternatives would alter potential habitat. There would be no disturbance by logging activities that are more than .25 miles from the potential nesting habitat. Recreational activities generally are focused on the open portions of the lake by fisherman or upland in the forest by campground users during the nesting period.

Determination

Because there would be no destruction of habitat or disturbance during critical breeding and nesting period, implementation of any of the alternatives would have no impact to tricolor blackbirds.

California Wolverine, *R6 Sensitive and MIS*

Existing Conditions

Wolverines occupy a wide variety of habitats from the arctic tundra to coniferous forest. The most common habitats are those that contain a high diversity of microhabitats and high prey populations. Wolverines also tend to avoid areas with high temperatures (Ruggiero et al 1994). Wolverines are opportunistic and will forage on whatever is readily available. Small mammals, hares and berries make up a large part of the diet in summer months, and large ungulates or carrion in winter (Ruggiero et al 1994). The most critical and limiting habitat for wolverines seems to be acceptable denning habitat. Denning habitat has been described as high elevation rocky slopes or cirque basins on north and east slopes that have persistent snow into the spring and summer months.

Unconfirmed wolverine sightings have been reported near Willamette Pass, on Maklaks Mountain, and near Crescent Creek. Potentially suitable denning habitat may be found in the Mt. Thielsen and Diamond Peak Wilderness areas. There is no denning habitat in the project area. It is assumed that wolverines may travel through and or forage infrequently at the lower elevations on the district, and utilize higher elevation habitat for most of its needs. Carnivore snow tracking, baited camera sets, and track plates have been used to try and detect marten, fisher, and wolverine presence on the district with surveys occurring in 1994, 1995, 1996, and 1998. There were no detections of wolverines. No surveys were conducted for this project.

Environmental Consequences

Direct, Indirect, and Cumulative Effects

Harvest of fire-killed trees would not alter the use of the area by wolverine. Prey availability would not be reduced by activities nor would they inhibit the wolverine's ability to travel across the landscape. Proposed activities would not take place within or adjacent to potential denning habitat.

Plantings proposed in the action alternatives would increase habitat for various prey species, especially small mammals, potentially increasing the prey base for predators such as the wolverine.

Determination

Wolverine are thought to be infrequent visitors to this area. Activity proposed in any of the action alternatives would not alter prey availability or use of the area by wolverine. Implementation of any of the alternatives would have **no impact** on wolverine.

Pacific Fisher, *R6 Sensitive*

Existing Conditions

Fishers utilize upland and lowland forests, including coniferous, mixed, and deciduous forests. They occur primarily in dense coniferous or mixed forests, including early successional forest with dense overhead cover (Thomas et al. 1993). They commonly use hardwood stands in summer but prefer coniferous or mixed forests in winter. Fisher tend to avoid open areas. Although adapted for climbing, fishers are primarily terrestrial. When inactive the fisher occupies dens in tree hollows, under logs, or in ground or rocky crevices, or rests in the branches of conifer trees during the warmer months. Young are born in a den in a tree hollow (usually), or under a log or in a rocky crevice. Large snags (greater than 20 inches dbh) are important as maternal den sites (Thomas et al. 1993).

Fishers probably select prey on the basis of availability and diets are typically diverse. Diets in the Pacific coastal states include porcupine, squirrels, woodrats, rabbits, mice, voles, marmots, beaver, quail and grouse. Fishers can be active during the day and/or at night.

Carnivore snow tracking, baited camera sets, and track plates have been used to try and detect marten, fisher, and wolverine presence on the district with surveys occurring in 1994, 1995, 1996, and 1998. There were no detections of fishers documented from these surveys. However, a juvenile male fisher captured and radio collared on the Rogue River National Forest in 1998 dispersed 45 miles to the Big Marsh area on the Crescent Ranger District. This animal was radio tracked until the transmitter battery died in December 1999. Fisher may disperse through the area. There are only two population of fisher in Oregon, one on the Rogue River National Forest and the other in southwestern Oregon along the Oregon-California border.

Environmental Consequences

Direct, Indirect and Cumulative Effects

Harvest treatments occur only in areas where there is 100% mortality. Fisher would tend to avoid these areas until recovery of the area to an early successional forest with dense overhead cover. This would occur in more than 100 years in Alternative A and 30 years in Alternatives B and C. All alternatives would have a mosaic of habitats. There would be varying densities of down wood. Alternatives B and C would remove the most snags, but retention of the largest material as well as snag clumps and leave areas would provide potential denning habitat. In California, private timber land is home to the largest population of fisher in the state. In this intensively-managed land, the fisher key in on areas of large down wood and legacy snags. The Davis project would leave wood in densities and patterns that would exceed that left in the area of the Northern California

population. Riparian areas would not be harvested. The few logs moved into the creek by the Odell Creek project would not impact the fisher use of the area.

Determination

Fisher are not known to utilize the area except as dispersing animals. They would avoid the intensely burned areas of the fire. All alternatives leave a legacy of down wood and snags in the riparian areas as well as in varying densities in the uplands. Planting by the action alternatives would provide habitat sooner than the no action alternative. Planting in the riparian area as provided in alternatives B, C and E would provide habitat sooner than the Alternatives A and D, which do not plant in the riparian zones. Implementation of the Alternative B, C and E would be beneficial for fisher habitat in the long term. In the short term implementation of any of the alternatives would have **no impact** on fisher.

Survey and Manage Species

In 1994 the Northwest Forest Plan developed a system of reserves, the Aquatic Conservation Strategy, and various standards and guidelines for the protection of old growth related species. Mitigation measures were also included for species that were rare, or thought to be rare due to a lack of information about them. It was unknown whether the major elements of the NWFP would protect these species. These species collectively known as Survey and Manage species were included in standards and guidelines under Survey and Manage, Protection Buffers, and Protect Sites from Grazing. An amendment in 2001 amended the survey and manage standards and guidelines; and a second amendment in 2004 removed or modified the survey and manage requirements; some species were moved to the Regional Forester's Sensitive Species list. The Davis Fire Recovery project was completed under the 2001 survey and manage ROD guidance as described below. This project is consistent, however, with guidance in the 2004 ROD to Remove or Modify the Survey and Manage Mitigation Measure Standards and Guidelines.

Those terrestrial species thought to occur on the Deschutes National Forest included the mollusk, Crater Lake tightcoil, (*Pristiloma arcticum crateris*), category B and the terrestrial vertebrate the great gray owl (*Strix nebulosa*), category C. Category B species are considered rare, where pre-disturbance surveys are not practical. However the Crater Lake tightcoil was included in a group of eight mollusk species where equivalent-effort pre-disturbance surveys were required, based upon direction in the record of decision for the 2001 amendment (USDA 2001). In the subsequent 2002 Annual Species Review Memorandum (USDA and USDI 2003), the Crater Lake tightcoil was changed from a category B to Category A, where species are considered rare and pre-disturbance surveys are considered practical.

Category C species are considered uncommon and pre-disturbance surveys are practical. During subsequent reviews, the status of the great gray owl has not changed.

Pre-disturbance surveys are to be conducted prior to signing NEPA decisions or decision documents for habitat-disturbing activities (USDA and USDI 2001 p S&G-21). "Habitat disturbing activities are defined as those likely to have a significant negative impact on the species' habitat, its life cycle, microclimate, or life support requirements. The evaluation of the scale, scope, and intensity of the anticipated negative impact of the project on habitat or life requirements should include an assessment of the type, timing, and intensity of the disturbing activity. "Habitat-disturbing" is not necessarily the same as "ground-disturbing"; helicopter logging or logging over snow-pack, for example, may not disturb the ground but might clearly affect microclimate or life cycle habitat factors. Conversely, an activity having soil-disturbing effects might not have a large enough scope to trigger a need to survey." (USDA and USDI 2001 S&G-22).

Others included

The white-headed woodpecker, black-backed woodpecker, pygmy nuthatch and flammulated owl are included as species not sufficiently provided for by the NWFP. These species were also included in the 2001 amendment.

Direction for managing these species includes retention of snags and green trees. Snags over 20 inches dbh may be marked for cutting only after retaining the best available snags (considering size, longevity, etc.) in sufficient numbers to meet 100 percent of the potential population levels of these four species (2001 amendment page S&G-34, 35). Analysis of these species was completed in the Snag Issue sections.

Bats

Most bat species roost and hibernate in crevices or caverns that maintain a specific range of temperatures and moisture conditions. (USDA and USDI 2001 S&G-37) Caves, mines, snags and decadent trees, wooden bridges and old buildings are commonly used. Management recommendations for bats including the fringed myotis, silver-haired bat, long-eared myotis, long-legged myotis, pallid bat, and Townsend's big-eared bat consist of protection of caves, abandoned mines, abandoned wooden bridges and abandoned buildings. Provisions for retention of large snags and decadent trees are included in the standard and guideline for green tree patches in the matrix. (USDA and USDI 2001 S&G-37-38)

Affected Environment and Environmental Consequences

Crater Lake Tightcoil

Existing Conditions

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

Threats to the species include activities that compact soils, reduce litter and/or vegetative cover, or impact potential food sources (i.e. livestock grazing, heavy equipment use, ORVs, and camping on occupied habitats). Fluctuations from removal of ground vegetation on ground temperature and humidity may be less extreme at higher elevations and on wetter sites, but no studies have been conducted to evaluate such a theory. These snails appear to occur on wetter sites than general forest conditions, so activities that would lower the water table or reduce soil moisture would degrade habitat (Burke et. al 1999). Due to the well draining pumice soils on the Crescent Ranger district, areas that retain permanent surface moisture are very narrow margins along the edge of streams or springs. In the project area those areas would be along Odell Creek and Ranger Creek.

Surveys completed (October 1999, June 2001) for the 7 Buttes Return project surveyed portions of Odell Creek and Ranger Creek found various mollusk species including Punctum, Discus and Pupillidae. No Crater Lake tightcoil were found.

Post-fire

The Davis Fire burned the overstory along Odell Creek and in a mosaic of intensities along Ranger Creek. Some logs that could serve as habitat were charred, but most of the features that would serve as habitat remained intact. Because the area had been previously surveyed, there are no habitat disturbing activities proposed along Odell and Ranger Creeks, and habitat would not be negatively affected, surveys were not needed and not completed for this project.

Environmental Consequences

Alternative A – No Action

Direct and Indirect Effects

Habitat for the Crater Lake tightcoil would not be altered. There would be no harvest activities, and no planting of hardwood vegetation along Ranger Creek or Odell Creek.

Alternative B, C, D and E

Direct and Indirect Effects

There is no proposed harvest along Ranger Creek or Odell Creek. No wood would be removed from the stream channel and/or the wetted riparian zone. Down wood along the margins of the creek provide microsites for hardwood seedlings. These sites would be taken advantage of with the implementation riparian planting. There would be little to no disturbance of down wood during the planting process.

Cumulative Effects All Alternatives

The Odell in-stream log placement project would require the use of equipment in the stream to move pieces of wood around. Placement of log structures within Odell Creek could change the hydrologic properties of stream channel by connecting the stream to the floodplain. While movement of wood and change of hydrologic properties would cause a disturbance to existing habitat, the disturbance of wood is only in short sections of Odell Creek, and the change in hydrologic regime back to the historic flood channels would potentially increase habitat for the Crater Lake tightcoil.

Consistency with Forest Plan as amended (NWFP Amendment ROD 2001)

Proposed activities do not alter habitat for the Crater Lake tightcoil. Actions are consistent with the NWFP as amended.

Great Gray Owl

Existing Conditions

Great gray owls generally inhabit open lodgepole or mixed lodgepole/ponderosa pine forests in mid- to late structural stages (lodgepole > 70 years, ponderosa > 200 years). Foraging habitat is typically defined as natural meadows greater than 10 acres in size, riparian areas, clear-cut and selectively logged areas where they forage on small mammals including shrews, voles, chipmunks, squirrels, and snowshoe hares.

Great gray owls do not build their own nests, but utilize nests created by other birds or formed by dwarf mistletoe brooms, depressions in broken-topped trees, stumps, or artificial platforms. Trees/snags used for nesting generally range from 18 to 37 inches dbh (Wisdom et al 2000, vol2-54-55). Within the range of the northern spotted owl, suitable nesting habitat may be found in mature forested stands with greater than 60 percent canopy cover although some nests have been recorded in stands with only 40 percent canopy cover.

Studies of Great Gray Owls east outside the range of the spotted owl found similar results (Bull and Henjum 1990, Bryan and Forsman (1987). These studies also found few owls above 4,900-5,400 foot elevation. Bryan and Forsman (1987) found great gray owls were widely distributed in south-central Oregon, but common only where there were concentrations of appropriate habitat.

While there may be habitat within the project area it is uncertain whether snow depths that persist into April prohibit occupancy. The owls plunge through the snow to capture prey at ground level. Snow levels may make prey less available. In eastern Oregon most great gray owls in the study area moved in the winter from areas that had accumulations of snow greater than 59 inches (150cm) to areas that averaged 20 inches. Snow depth was also found to delay nesting at the higher elevations in the eastern Oregon study from mid-March to early April. Bryan and Forsman (1987) found concentrations of great gray owls 1-5 miles east of the project area, southeast of Wickiup Reservoir and west of the Little Deschutes River. Elevations in this area range between 4,200 and 4,400 feet. None were found in the Davis Project area at the time of the study. The nearest known great gray owl nest is 9 miles south of the project area on Refrigerator Creek, where the elevation is approximately 4,700 feet. With elevations within the project area ranging from 4,400 feet to 7,089 feet it is questionable if the area provides habitat. Habitat may be limited to 9,800 acres in the lower elevations (4,400-4,900 feet). This includes approximately 6,500 acres next to Davis Lake, 1,400 acres next to Wickiup Reservoir, and an additional 1,900 acres outside the NWFP area next to Wickiup Reservoir.

Riparian areas, meadow habitat, and open lodgepole wet plant associations are likely foraging habitat in the planning area. Nesting habitat on the Crescent Ranger District consist of older stands of lodgepole pine with ponderosa pine or Engleman spruce, a canopy cover exceeding 40 percent, and within 0.25 mile of foraging habitat. Potential nesting habitat occurs along Odell Creek drainages outside the project area and on the south side of Davis Lake and Wickiup Reservoir in those years when the water levels are low.

Great gray owl surveys were conducted in the project area and surrounding area for the Seven Buttes Return project in 1999 and 2000 with six protocol conducted visits completed each year within suitable habitat. Surveys did not detect the presence of any great gray owls in the Seven Buttes Return planning area.

Post-Fire

Davis fire removed the canopy over 75% of the fire areas burned with moderate and high intensity. There is no longer any nesting habitat for great gray owls within those areas. Foraging areas may have increased at the lower elevations where great gray owls may be found. Unburned green stands with large tree structure adjacent to these areas, may now become more suitable for the owl due to the proximity of foraging habitat.

Environmental Consequences

Common to All Alternatives

The areas burned with moderate and high intensities on the flats and uplands next to Davis Lake and Wickiup could become foraging habitat for the great gray owl. Small mammal populations would begin to colonize from the edges and move into these areas as down wood, shrub, forbs and grasses become available for cover and food. Populations may reach levels to support great gray owls within 3-5 years post-fire.

There is no proposed harvest in nesting habitat in any of the action alternatives. Nesting stands within the planning area are limited to the edges of the moderate and high intensity burn. Large snags upslope from the lodgepole flats could provide nesting habitat where they age, break and decay sufficiently to provide natural platforms. Green tree nests built by other species (goshawk) would probably be limited to stands adjacent to foraging habitat outside the planning area in the Davis Lake area and underburned or unburned portions next to Wickiup Reservoir.

Alternative A

There would be no harvest of snags or treatment of downed fuels in the uplands surrounding the lodgepole flats in Alternative A. Without planting the lodgepole may naturally regenerate, potentially leaving some open areas for foraging. Under alternative A these areas would remain open longer as natural regeneration would be a mosaic of tree densities. Nest trees would remain in the small unburned pockets within the planning area and existing stands outside the planning area adjacent to foraging areas.

Alternatives B, C, D and E

Direct and Indirect Effects

In the uplands (below 4,900 feet elevation) adjacent to the lodgepole flat of Odell Creek Alternatives B, C, would salvage 2,058 acres, Alternative D 387 acres and Alternative E 968 acres, removing snags and treating fuels on the flats and uplands next to the lake and reservoir. Treatments would reduce the number of perch trees available. It would also reduce the amount of down wood that would be available for prey species. These alternatives would plant harvest units as well as an additional 200 acres of lodgepole within the Key Elk area, and 100 acres of hardwoods along Odell Creek. Key Elk planting would take place only if natural regeneration was not becoming established within 2 years. Once trees became established, after 15-20 years, foraging habitat would be eliminated.

Table 3.83 Harvest within Potential Great Grey Owl Habitat

Acres of Harvest by Alternative			
Location	ALT B or C	ALT D	ALT E
Davis Lake (LSR)	1672	0	702
Wickiup Reservoir (Matrix)	289	289	258
Wickiup Reservoir (East)	98	98	8
Grand Total	2058	387	968

It would be approximately 50-100 year until trees in these units would begin to be large enough to attract goshawk to build nests, which the great gray owl could then utilize. Large snags (36+ inch dbh) would still be within these areas at decreasing densities for 25-40 years and could potentially provide limited nesting opportunities.

Mitigation measures would be in place for implementation of any of the action alternatives. These include monitoring of forest adjacent to the burn for the next 2-6 years to determine if any great gray owls establish nesting territories and apply disturbance restrictions if any nests are found.

Cumulative Effects

The Davis fire increased potential foraging habitat adjacent to Davis Lake. There are no activities planned other than the proposed salvage for the project area that would affect great gray owl use of the area. Hazardous fuels treatments in the wildland urban interface of La Pine, such as the Thaw project, should improve habitat for the great gray owl, where they are currently concentrated. These treatments remove or reduce the density of small understory trees adjacent to meadows and riparian area Long Prairie and reducing the threat to the larger overstory. Other similar projects in the La Pine area may occur with the latest wildland-urban interface hazardous fuels reduction priorities, and healthy forest initiative.

Consistency with Forest Plan as amended (NWFP Amendment ROD 2001)

Specific mitigation measures for the great gray owl include a no-harvest buffer of 300 feet around meadows and natural openings, and a ¼-mile protection zone around known nest sites.

There are no harvests of green trees proposed within 300 feet of meadows and natural openings. There currently are no known nests in or adjacent to the planning area. Nest and disturbance buffers would be put in place if and when a new nest is found. The project is consistent with NWFP.

Fringed myotis, Silver-haired bat, Long-eared myotis, Long-legged myotis, Pallid bat, and Townsend's big-eared Bat

Existing Conditions

Sites commonly used by bats include caves, mines, snags and decadent trees, wooden bridges and old buildings. The bats in this group vary slightly on habitat use. The fringed myotis, Townsend's big-eared bat, pallid bat, and silver-haired bat focus on cave and rock crevice habitat, the long-legged bat and the long-eared myotis utilizes both caves and snags. The silver-haired bat relies heavily on standing snags and hollow trees in and adjacent to riparian areas that are used for foraging. (NatureServe 2003)

There are no wooden bridges, abandoned structures or known caves or mines in the Davis project area. The lava flow on the north of Davis Lake and outside the project area would provide rock crevices for day roosts in the summer. Snag levels within the riparian areas varied with large numbers of lodgepole pine snags along Odell creek, and a larger mix of lodgepole and ponderosa pine next to Ranger creek. Actual densities are unknown.

The Davis fire did not affect any of the rock habitat. It did however create an abundance of snags within the riparian areas of Ranger Creek and Odell creek and throughout the project area.

Limited bat surveys have been conducted on the Crescent Ranger District. Surveys of the wooden bridge of Odell Creek plus the concrete and wood bridges on Odell Creek, Crescent Creek, and the Little Deschutes River on the Highway 58 corridor occurred in 1996 and 1997. One long-eared myotis was detected day roosting under the Odell Creek concrete and wooden bridge during the 1996 survey.

Environmental Consequences

Common to All Alternatives

The early post-fire insect outbreaks may initially attract additional bats to feed in the project area. Potential roosting habitat would be available on snags with cavities or broken tops and under bark as sloughing begins to occur. Increases in shrubs may extent the increase of insects throughout the project area.

Alternative A

Direct and Indirect Effects

Loss of roosting habitat would occur over time as snags fell down. Lodgepole pine and shrubs would become established throughout most of the moderate and high burn intensity areas.

Alternatives B, C, D, and E

Direct and Indirect Effects

Although the action alternatives harvest the majority of the snags, within the units the largest snags (36+ inches dbh) would remain, 15 percent retention areas would be designated and varying densities of snags would be left across the landscape. Shrub development would be greatest in unharvested stands. Tree development would bring a different suite of insects. Harvest varies by alternative with the greatest in alternatives B and C at 6,355 acres, 3,290 acres in alternative E and the least in D with 1,045 acres.

Cumulative Effects

Mines, caves and rock outcrops are protected in all projects on the Crescent Ranger district as required by the Deschutes National Forest LMP. All snags are left where they do not pose a hazard on all green timber sales outside the planning area. Proposed enhancement of Odell creek would increase amount of water and associated wetland, providing additional breeding areas for insects. There are no future harvest activities planned within the Davis project area.

Recreational expansion and development of Lava flow campground could increase disturbance to bats utilizing the lava flow. Recreational use is generally focused on Davis Lake or along the edges of the lava flow where

historic duck blinds were created by shifting rocks around. It is unknown how much recreational use occurs on the Lava flow. Because of the difficulty of navigating the lava flow the amount of disturbance is thought to be limited to a small area compared to available habitat. The greatest use occurs along the edge of the lake from October through January when duck hunting from lava rock blinds is fairly common.

Consistency with Forest Plan as amended (NWFP Amendment ROD 2001)

The project retains all 36+ inch snags, and does not harvest within the riparian buffer. All alternatives retain 15% of each harvest unit untreated except alternative D. Alternative D has design elements to protect slopes over 25%. In most units this exceeds 15% of each of the harvest units. There are no known caves or rock outcrops in the project area; any found would be protected. The project is consistent with NWFP.

Management Indicator Species

Other species of Concern

Generally three documents provide guidance or species lists for consideration in the management of federal lands. Management actions should minimize negative impacts, promote habitat development or provide habitat protection to some degree for those species that occur within the habitats of federally managed land. The three documents and associated species lists include the Deschutes National Forest - Management Indicator Species, the U.S. Fish and Wildlife Service Birds of Conservation Concern, and A Conservation Strategy For Landbirds of the East-Slope of the Cascade Mountains In Oregon and Washington. Species listed in these documents overlap with each other as well as the threatened, endangered and sensitive species lists.

Habitat manipulation affects species differently. An action that may increase habitat for one species may decrease habitat for another species. Federal threatened, endangered and sensitive species lists are always consulted first. Species that do not appear on these lists but show up as a management indicator species or focal species or species of concern may have persistence issues at a regional or national level but may not have persistence issues at a local or state level. In order to get an idea of the level of concern for these species, rankings were obtained from NatureServe Explorer: An online encyclopedia of life, available at http://www.natureserve.org/explorer. Rankings are given for global, national and state levels. Only the state rankings will be used in this analysis. The Oregon State Heritage ranks species LOOK THIS UP ability to persist in the state, based on habitat and population trends. The ratings 7 main categories: SX-Presumed Extirpated, SH-Possibly Extirpated, S1-Critically Imperiled, S2-Imperiled, S3-Vulnerable, S4-Apparently Secure and S5-Secure. There are also 6 minor categories that include: SR-Reported, SZ-Migratory Transient, SE-Exotic, S?-Unranked, Under Review, and SU-Unrankable.

Management Indicator Species

During the preparation of the Deschutes National Forest Land and Resource Management Plan (USDA 1990), a group of ten wildlife species were identified as management indicator species (MIS). These species were selected because their welfare could be used as an indicator of other species dependent upon similar habitat conditions. Indicator species can be used to assess the impacts of management actions on a wide range of other wildlife with similar habitat requirements. The species selected for the Deschutes National Forest include the American marten, black-back woodpecker, California wolverine, Cooper's hawk, elk, golden eagle, great blue heron, mule deer, northern bald eagle, northern goshawk, northern spotted owl, osprey, peregrine falcon, red-tailed hawk, sharp-shinned hawk, Townsend's big-eared bat, waterfowl and the woodpecker guild.

All but the following have been covered in previous sections: Cooper's hawk, golden eagle, great blue heron, northern goshawk, osprey, red-tailed hawk, and sharp-shinned hawk.

Great Blue Heron

Existing Conditions

The great blue heron is one of the most wide-ranging waterbirds in Oregon (Marshall 2003). Oregon State Heritage rates the great blue heron as S4, apparently secure (NatureServe 2003). Highly adaptable, it is found along estuaries, streams, marshes and lakes throughout the state. Nest locations are in the proximity of available food. Great blue heron nest in colonies in shrubs, trees and river channel markers where there is little disturbance (Marshall 2003). Tree species they would utilize in the project area include ponderosa pine and Douglas-fir. While average dbh of nest trees were 4.5 feet, they use a wide range of sizes from 1.5 to 6 feet in diameter (Marshall 2003). They hunt shallow waters of lakes and streams, wet or dry meadows feeding on fish, amphibians, aquatic invertebrates, reptiles, mammals and birds. Foraging habitat in the project area include the shallow water of Davis Lake, Odell Creek, Ranger Creek and the associated marshes and riparian habitat. There are no known colonies in the Davis project area.

Davis Fire eliminated potential nesting habitat along portions of Odell and Ranger Creeks and Davis Lake. It probably reduced prey numbers within the moderate and high intensity burns in the riparian areas of Odell Creek. Small mammals, reptiles and amphibians should easily colonize these areas as they are linked to unburned or underburned areas. Aquatic species were generally unaffected by the fire (See Fisheries section).

Environmental Consequences

Direct and Indirect Effects Alternatives

There are no riparian proposed harvest treatments in any of the alternatives. The riparian areas along Davis Lake and Ranger Creeks will recover naturally, with grasses, sedges and shrubs. The process began immediately after the fire. The action alternatives all propose supplemental planting along Odell Creek, in time these hardwoods may provide nesting habitat.

Cumulative Effects All Alternatives

The Odell in-stream log placement project may require the use of equipment in the stream to move pieces of wood around. Placement of log structures within Odell Creek could change the hydrologic properties of stream channel by connecting the stream to the floodplain. There would be disturbance caused by the equipment potentially causing heron to avoid the area; however it would occur only in short sections of Odell Creek at a time. The change in hydrologic regime back to the historic flood channels would increase moisture regimes in adjacent areas potentially increasing foraging habitat for the great blue heron.

Consistency with the Deschutes Land and Resource Management Plan

The proposed project does not remove habitat for the great blue heron. If heron rookeries are discovered in the project area, limited operating period would be applied as needed. The project is consistent with the Forest Plan (DLRMP 4-55, WL-35,36).

Hawks, Eagles and Allies

Existing Conditions

The red-tail hawk has increased and expanded its range since Euro-American settlement (Marshall 2003). While it was selected as a management indicator species for large trees in mixed habitat it uses any habitat that has perches to hunt from and open enough to prey on the ground. Perches used included trees of all sizes to telephone poles. Red-tails also use a wide variety of structures for nests, including trees, utility poles and cliffs (Marshall 2003). Because they place their nests higher in trees than other buteos, they generally select larger

trees or smaller deformed trees where branch structure supports this higher placement. There were 4 known red-tailed nests in the project area and numerous sightings. Red-Tailed hawks are ranked S5, secure in the state (NatureServe 2003).

The golden eagle is a large open country bird. It nests in open large (>30 inch dbh) live ponderosa pine or cliff ledges that support its 3-10 foot tall nest (Marshall 2003). Because of the in-growth of shade tolerant species there was little habitat for the golden eagle in the project area. Nesting habitat would most likely occur within the lava flow NE of Davis Lake and outside the project area. The lake and open meadow, marsh habitat as well as harvest units such as shelterwoods that preserved the largest ponderosa pine trees provide foraging areas for the golden eagle. There are no known golden eagle nest sites in the project area and only one sighting. The Davis fire opened up approximately 16,000 acres of habitat, however smaller prey species would be lacking in the center of the moderate to high intensity blocks for several years. Oregon Heritage rank golden eagles as S4 apparently secure.

Osprey are associated with lakes and rivers. They nest within two miles of fish-bearing bodies of water. They generally nest in larger broken top live trees or snags, but also utilize utility poles, man-made Canada goose nest boxes, channel markers and other man-made structures where natural structures are lacking (Marshall 2003). Osprey have overcome the decline in population in the 50's and 60's due to DDT and are expanding due to man-made reservoirs and artificial nesting structures (Marshall 2003). They are currently ranked as S4, apparently secure. There are 3 known nests in the project area and numerous sightings. The Davis fire created nearly 20,000 acres of snags within 2 miles of Davis Lake and Wickiup reservoir.

The remaining three hawks often coexist in the same area. To a degree they partition the habitat and prey. The sharp-shinned hawk, ranked S4, apparently secure, is the smallest of the three; prey to the larger two; and the hardest to detect. It nests in dense younger stands and preys almost entirely on small birds. The next in size is the Cooper's hawk, ranked S4, apparently secure. It utilizes young to mid-aged dense stands and feeds on a variety of birds and small mammals found on the ground-shrub level to the shrub canopy level. The Goshawk, largest of the three, ranked S3, vulnerable, is generally associated with ponderosa pine. It uses mid to old aged stands with varying densities. It uses dense stands for nesting and the more open stands for hunting. Its prey includes a wide variety of birds and mammals. Cooper's hawk and the sharp-shinned hawk are often tied in with riparian areas where there are a greater diversity and density of prey species. Habitat was abundant for all species in the planning area with approximately 4,800 acres in early seral, 16,800 acres in mid-aged multi-story and 1,870 acres in late multi-story. There was very little open late successional habitat, so foraging habitat was very limited for goshawks. There have been a few sightings of the hawks in the project area. There were no known nests for goshawks and sharp-shinned hawks and 1 known nest for Cooper's hawk.

The Davis fire eliminated most of the habitat for these hawks, converting most stands 16,900 acres to a stand initiation structure, with no trees. Available for the three would be 500 acres mid-aged multi-story and 13 acres of mid-late multi-story, and 300 acres of single story with large. The remaining acreage, 3,400 was in stem exclusion, open canopy which is a mosaic of large trees with scattered understory. This structure would provide foraging habitat for the goshawk, but generally not nesting.

Environmental Consequences

Common to All Alternatives

The areas burned with moderate and high intensities (100% mortality) over 15,700 acres and underburned an additional 4,400 acres opening up foraging habitat for all the hawks, and golden eagle. Small mammal populations would begin to colonize from the edges and move into these areas as down wood, shrub, forbs and grasses become available for cover and food. Populations levels would increase within 3-5 years post-fire.

There is no proposed harvest in nesting habitat in any of the action alternatives for the hawk and golden eagle. Nesting stands within the planning area are limited to the unburned portions of the project area and stands adjacent to foraging habitat outside the planning area in the Davis Lake area and underburned or unburned portions next to Wickiup Reservoir.

Alternative A

There would be no harvest of snags or treatment of downed fuels in Alternative A. Without planting, the lodgepole may naturally regenerate across most of the 100% mortality areas, resulting in a mosaic of densities with open areas for foraging. Under alternative A these areas would remain open longer as natural regeneration would be a mosaic. Nest trees would remain in the small unburned pockets within the planning area and existing stands outside the planning area adjacent to foraging areas. Osprey would have the full selection of snags to choose from for nesting.

For the hawk and golden eagle, there would be no development of nesting habitat for 100-150 years, as lodgepole would dominate and larger diameter nest trees preferred by these species would not develop.

Alternatives B, C, D and E

Direct and Indirect Effects

Alternatives B and C would salvage 6,355 acres, Alternative D 1,045 acres and Alternative E 3,290 acres, removing snags while treating fuels. Treatments would reduce to varying degrees the number of perch trees and plucking posts available for the hawks. It would also reduce to varying degrees the amount of down wood that would be available for prey species. Although all alternatives retain snags 36 inch dbh and above, snags smaller than that would be removed at varying levels, resulting in a reduction of the total number snags for the osprey to select from.

These alternatives would plant harvest units as well as additional reforestation units killed with the fire. Alternatives B and C plant the most acres with a total of 8,400 acres, Alternative E next with 3,910 and Alternative D at 2,030 acres. Habitat would be provided for the sharp-shinned hawk first approximately 30-40 years in these planted stands as tree sizes it prefers is smaller than the other hawks. Coopers would be able to find larger tree habitat in 40-50 years. It would be approximately 50-100 years until trees in these units would begin to be large enough to attract goshawk to build nests. It would be an additional 100 years for this area to produce trees large enough to support a golden eagle nest.

Mitigation measures would be in place for implementation of any of the action alternatives. These include monitoring of forest adjacent to the burn for the next 2-6 years to determine if any raptors establish nesting territories and apply disturbance restrictions if any nests are found.

Cumulative Effects

The Davis fire increased potential foraging habitat adjacent to Davis Lake. There are no other activities planned other than the proposed salvage for the project area that would affect hawks, eagle and osprey use of the area.

Consistency with the Deschutes Land and Resource Management Plan

There would be no removal of existing nest trees. There would be no alteration of existing nesting habitat for any of the species except the osprey. Retention of the largest snags across the area as well as 15% snag retention areas would provide for the osprey. Restrictions for disturbance are included in the mitigation measures. The project is consistent with the Forest Plan.

Birds of Conservation Concern

In January 2001, President Clinton issued an executive order on migratory birds directing federal agencies to avoid or minimize the negative impact of their actions on migratory birds, and to take active steps to protect birds and their habitat. Within two years, federal agencies are required to develop a Memorandum of Understanding (MOU) with the U.S. Fish and Wildlife Service to conserve migratory birds including taking steps to restore and enhance habitat, prevent or abate pollution affecting birds, and incorporating migratory bird conservation into agency planning processes whenever possible. Toward meeting this end the U.S. Fish and Wildlife Service developed the Birds of Conservation Concern released in February 2002. This document lists those species the USFWS feel are in greatest need of conservation action at different geographic scales. It does not include any conservation measures. Crescent Ranger District would be included in the Bird Conservation Area 9, the Great Basin. Birds included on that list are: Swainson's hawk, ferruginous hawk, golden eagle, peregrine falcon, prairie falcon, greater sage-grouse, American golden-plover, snowy plover, American Avocet, solitary sandpiper, whimbrel, long-billed curlew, marbled godwit, sanderling, Wilson's phalarope, yellow-billed cuckoo, flammulated owl, burrowing owl, black swift, Lewis's Woodpecker, Williamson's sapsucker, white-headed woodpecker, loggerhead shrike, gray vireo, Virginia's warbler, brewer's sparrow, sage sparrow, tricolored blackbird.

The golden eagle, peregrine falcon, flammulated owl, Lewis's woodpecker, Williamson's sapsucker, white-headed woodpecker, and tricolored blackbird have been covered in previous section of this report. The remaining species prefer grassland, shrub-steppe, mudflats, large marsh, large hardwood riparian or waterfall habitat and do not have habitat within the project area.

Grassland species include: Swainson's hawk, long-billed curlew, logger head shrike.

Sagebrush, shrub-steppe habitat species include: ferruginous hawk, greater sage-grouse, brewers sparrow, sage sparrow.

Pinyon-juniper forest habitat species include: gray vireo and Virginia's warbler.

Mudflats and/or alkaline lakeshore species include: American avocet, American golden-plover, snowy plover, whimbrel, sanderling.

Marsh species include: solitary sandpiper, marbled godwit, Wilson's phalarope

Riparian hardwood species include: yellow-billed cuckoo

Species that seek waterfalls in true fir/mountain hemlock forests is the black swift.

Landbird Strategic Plan

The Forest Service has prepared a Landbird Strategic Plan (January 2000) to maintain, restore, and protect habitats necessary to sustain healthy migratory and resident bird populations to achieve biological objectives. The primary purpose of the strategic plan is to provide guidance for the Landbird Conservation Program and to focus efforts in a common direction. On a more local level, individuals from multiple agencies and organizations within the Oregon-Washington Chapter of Partners in Flight participated in developing a publication for conserving landbirds in this region. A Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains In Oregon and Washington was published in June 2000 (Altman 2000). This strategy has been used since its development in planning and projects analysis. The Crescent Ranger District falls within the Central Oregon/Klamath Basin subprovince. The species select in the conservation strategy represent focal species for habitats types or features considered at risk. The following table shows the focal species for the habitats that occur with in the project.

The Conservation Strategy for Landbirds of the east-slope of the Cascade Mountains in Oregon and Washington (Altman 2000) recommends in its biological objectives for ponderosa pine and mixed conifer forest "Retain all Large diameter (>53cm [20 in]) trees and snags." These recommendations are for the management of green stands as Altman goes further, in recommending prescribed fire to maintain or enhance ponderosa pine habitat. He recognizes restoration of functioning forest ecosystems will meet the goal of healthy

landbird populations. Restoring ponderosa pine habitat and maintaining it with fire requires management of fuels. In management recommendations specific to the Lewis woodpecker, and/or the conservation focus of patches of burned old forest, he recommends leaving greater than 50% of burn larger than 100 acres unsalvaged as well as retaining all trees and snags greater than 20 inches dbh and greater than 50% of those 12 to 20 inches dbh. Davis fire is approximately 20,000 acres. It is large enough to meet multiple objectives including snags and down wood for woodpeckers. For this reason the IDT proposes to manage snags and down wood at varying levels across the landscape leaving various amounts of snags and down wood as well as areas of untreated snags and fuels. While not meeting the specific recommended levels, all the action alternatives meet the intent of restoration of a functioning ecosystem, leaving snags and down wood for the specific species.

Other prominent papers include a commentary by Beschta et al (1995) that recommended no salvage or retention of 50% of standing dead trees in each diameter class, and all trees greater than 20 inches dbh or older than 150 years. Unfortunately Beschta recommends a blanket snag prescription for all fires. Historical snag levels varied greatly across the landscape, based on natural disturbance regimes. While Beschta recognizes "forest management may have set the stage for fires larger and more intense than have occurred in at least the last few hundred years" he does not include management of those areas post burn to allow fire regimes to be reestablished at historical intensities.

Table 3.84 Migratory Focal Species

Species	Status	Behavior	Habitat Feature/Conservation Focus	Habitat	Presence in Project Area
Lewis' Woodpecker	Migratory Focal Species, Bird of Conservation Concern	primary cavity excavator	patches of burned old forest	Ponderosa Pine	Unknown
Williamsons' Sapsucker	Migratory Focal Species, Bird of Conservation Concern	primary cavity excavator	large snags	Mixed Conifer	Documented
Hermit thrush	Migratory Focal Species	ground feeder, ground, low veg nester	multi-layered/ dense canopy	Mixed Conifer	Unknown
Olive-sided flycatcher	Migratory Focal Species	aerial feeder	edges and openings created by wildfire	Mixed Conifer	Unknown
Flammulated Owl	Migratory Focal Species NWFP Survey & Manage, Bird of Conservation Concern	secondary cavity user	Large snags	Ponderosa Pine	Documented
Black-back Woodpecker	Migratory Focal Species, NWFP Survey & Manage, MIS	primary cavity excavator	Old Growth	Lodgepole Pine	Documented
White-Headed Woodpecker	NWFP Survey & Manage, Migratory Bird Focal Species, Bird of Conservation Concern	primary cavity excavator	Large patches of old forest with large snags	Old Growth Ponderosa Pine	Documented

All species except the hermit thrush are discussed in the snag issue portion of the analysis.

Hermit Thrush

Existing Condition

The hermit thrush is a summer resident of mature and old-growth forest with dense shrub or small tree understory. They nest on the ground, in brush or small trees. It is an opportunistic ground forager, feeding on insects and an occasional reptile or amphibian (Marshall 2003). They are considered S4, apparently stable in Oregon.

Habitat for the hermit thrush was variable across the planning area with approximately 15,500 acres of mid to late multi-story old growth habitat, and varying densities of shrubs and small trees in the understory. An ongoing study of birds in forested landscapes surveyed for forest-dwelling thrushes in campgrounds including Lava Flow and East and West Davis Campgrounds. Birds surveyed for included the Swainson's thrush, hermit thrush and varied thrush. These species were not found at any of the campgrounds or control points in the project area (Shunk 2001).

The Davis Fire eliminated habitat on all but 550 acres of mid to late multi-story habitat. Under burning in a third of those acres will produce a mosaic of open and close over story, and removing the understory brush and trees. Recovery of brush and understory trees should occur relatively quickly in these areas.

Environmental Consequences

Alternative A

There would be no harvest of snags or treatment of downed fuels in Alternative A. Without planting lodgepole and brush would naturally regenerate across most of the 100% mortality areas, resulting in a mosaic of densities. However the multistoried structure preferred by the hermit thrush would not develop. Mixed conifer species preferred by the hermit thrush would occur in small scattered patches. Late-old structure would not begin to develop for 100-150 years.

Alternatives B, C, D and E

Direct and Indirect Effects

Alternatives B and C would salvage 6,355 acres, Alternative D 1,045 acres and Alternative E 3,290 acres. These alternatives would plant harvest units as well as additional reforestation units killed with the fire. Alternatives B and C plant the most acres with a total of 8,400 acres, Alternative E next with 3,910 and Alternative D at 2,030 acres. Multi-storied habitat for the hermit thrush would begin to develop over the first 100 years as mixed conifer tree species would be in place to grow and develop. Introduction of fire in the first 40-60 years would increase the average diameter. It would be at that time stands would start taking divergent paths as a portion of the area would need to be managed for higher densities for the Northern spotted owl. The remaining area would go through several fire cycles to develop large tree structure faster. The second century understories would be developed throughout mixed conifer habitat.

Cumulative Effects

Hermit thrush mixed conifer multi-storied habitat has decreased over the last few years with fires and timber harvest. See Spotted Owl discussion, and Old growth discussion in the vegetation section. It is expected to continue to decrease over the short term as stands that are dominated by ponderosa pine are managed in a more open condition, and stands that support a denser mixed conifer forest are set back in order to provide for continuing large tree habitat over the landscape.

Consistency with the Conservation Strategy for Landbirds of the East-Slope of the Cascade Mountains in Oregon and Washington

The Conservation strategy states the justification for mixed conifer as a priority habitat is due to the loss of the late-successional stage of the habitat. They do not include sites that were historically ponderosa pine but converted to mixed conifer due to fire suppression and encroachment of other conifers. Conservation strategies associated with the hermit thrush include retaining tracts of forest as unmanaged or lightly managed to ensure structural diversity, including vertical diversity

The project does not remove or manage any remaining unburned or underburned mixed conifer habitat. The project is consistent with the Conservation Strategy for hermit thrush.

Big Game – Deer and Elk

The 21,000-acre Davis Fire Recovery planning area is summer range for deer and elk within the 885,000 acre Upper Deschutes Big Game Management Unit. Objectives for this Management Unit are for 950 elk for a summer population and 150 elk for a winter population; 2,200 deer with a ratio of 15 males to 100 does and an annual recruitment of 35 fawns to 100 does. Management objectives were developed with the Oregon Department of Fish and Wildlife for this area. Current populations are meeting/exceeding management objectives.

Management Direction

The Deschutes National Forest Land and Resource Management Plan (Deschutes LRMP, WL-47) defines suitable hiding areas as a stand that meets one of the following conditions.

- Six acre or larger stand capable of hiding 90% of a standing adult elk or deer from human view at a distance of 200 feet.
- Six acre or larger stand with an average height of 10 feet and which has not been thinned for 20 years. For deer it is an average stand height of 6 feet which has not been thinned for 15 years.
- Residual clumps of two acres (1/2 acre for deer) or larger stands within units with advanced regeneration and at least 12, greater than 7-inch diameter trees/acre remaining after timber harvest.

Suitable thermal cover for elk must be at least 10 acres, and have an average height of at least 40 feet. As a minimum, canopy cover must be 40% to qualify as thermal cover, but higher canopy cover percentages will be preferred. Stands may provide both hiding area and thermal cover (WL-50). For deer hiding cover is suitable thermal cover (WL-57).

Existing Conditions

Because tree density in stands are highly variable and within cover stands there are varying amounts of hiding and/or thermal cover, for this analysis hiding cover and thermal cover are not defined separately except for the discussion of the key elk area and in the effects analysis where development of hiding cover is important.

Prior to the fire there was ample hiding and thermal cover across the planning area, 80% of the project area with 17% in forage. The remaining 3% is Davis Lake high water/shoreline areas that do not necessarily provide forage during low water years. Seventy-four percent (15,600 acres) of the Davis Fire burned with moderate or high intensity, killing all vegetation (100% mortality) and eliminating cover and foraging habitat. There remains 17% hiding/thermal cover and 6% forage in the planning area. Forage in areas of 100% mortality has started to develop as grasses, sedges, ceanothus, and chinquapin resprouted within a few weeks after the fire. Bitterbrush had not resprouted by the end of October.

Key Elk Area: The planning area also includes 1,852 acres of the 2,083-acre Davis Key Elk Area, located just south of Davis Lake. The Deschutes National Forest Land and Resource Management Plan objectives for key

elk areas Forest-wide is to maintain habitat conditions to support at least 1,500 summering elk and 240 wintering elk. Forest plan standards and guidelines recommend a minimum of 20 percent of the capable forested acreage be maintained in a thermal cover condition and at least 30 percent be maintained as hiding cover.

Hiding cover is defined as vegetation capable of hiding 90% of a deer at 90 feet; at a minimum it must be at least 5 feet in height. Thermal cover is 40% canopy and 30 feet tall; minimum 30% canopy and 15' tall.

Prior to the fire, 73% of the Key Elk Area provided hiding/thermal cover and 26% forage (1% in shoreline). The fire burned 1,373 acres (66%) of the area with moderate or high intensities (100% mortality) eliminating cover and foraging habitat. The remaining unburned portion is in 24% of thermal/hiding cover and 9% forage (1% in shoreline). Forage in areas of 100% mortality has started to develop as grasses and sedges resprouted in moist areas. There is little to no ceanothus or chinquapin in the Key Elk Area and bitterbrush has not resprouted.

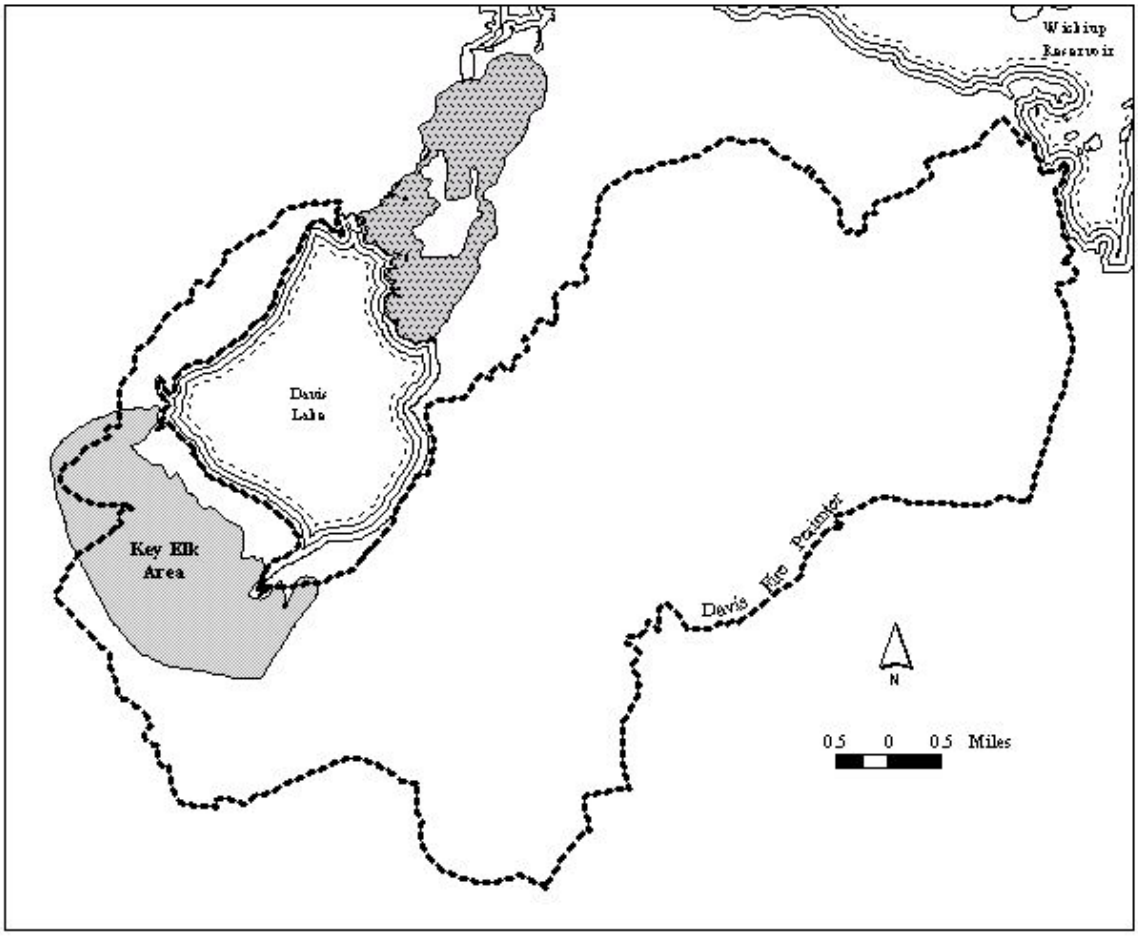


Figure 3.22 Location of Davis Key Elk Area

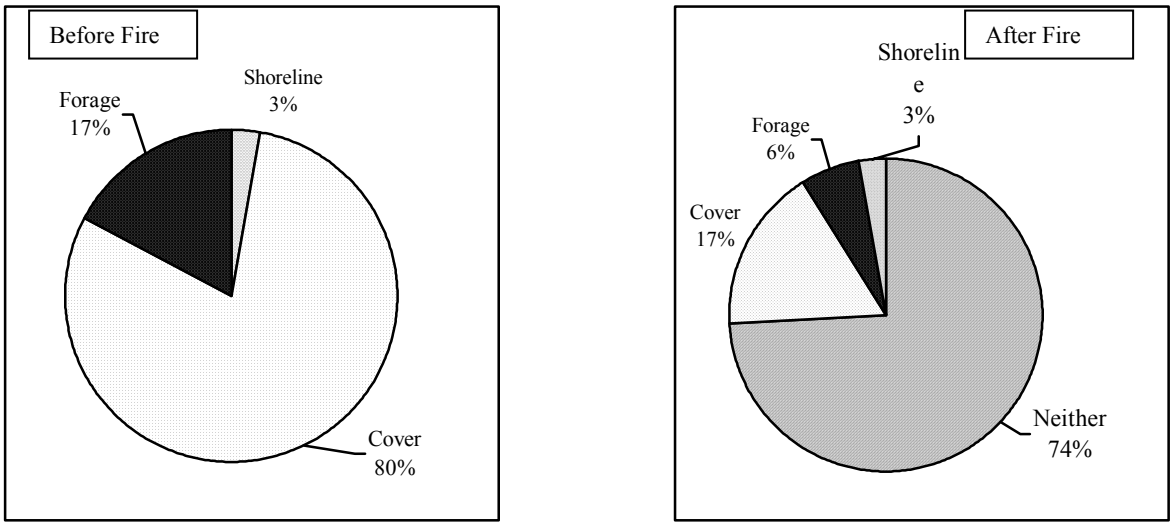


Figure 3.23 Cover/Forage In Project Area Before and After Fire

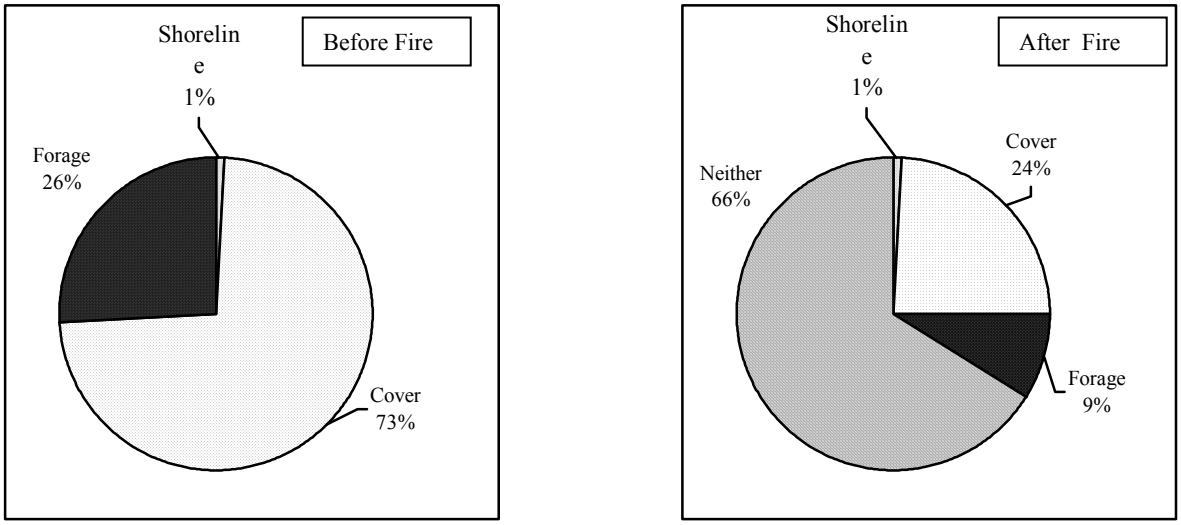


Figure 3.24 Cover/Forage in Key Elk Area Before and After Fire

Table 3.85 Big Game Cover and Forage Across Project Area and Key Elk Area

		Pre-Fire				Post-Fire			
		Forage		Cover		Forage		Cover	
	Total Acres	Acres	% of Area	Acres	% of Area	Acres	% of Area	Acres	% of Area
Project Area	21,000	3,608	17%	16,815	80%	1,305	6%	3,539	17%
Key Elk Area	2,083	534	26%	1,518	73%	189	9%	498	24%

Open road density in the Davis Travel Management Area is 7.27 miles per square mile. This exceeds the Forest Plan standards of 2.5 miles per square mile. The Key Elk area also exceeds the Forest Plan standard of 0.5-1.5 miles per square mile with 3.76 miles per square mile. After the Davis Fire an area closure was put into place and only major roads were open for public travel. The current area closure, signed March 26, 2004, was implemented April 30, 2004. Open road density within the Travel Management Area is 1.6 miles per square mile and 1.95 miles per square mile within the key elk area. A long term access management strategy for the area was analyzed in the Davis Roads Analysis. The strategy included opening roads in order to develop through routes to allow strategic access and close more dead end roads. This strategy will be analyzed in a separate document after the area closure is lifted in approximately 3-5 years.

Environmental Consequences

Alternative A – No Action

Direct and Indirect Effects

There would be no harvest, and no planting of trees or forage. While standing dead trees do provide some visual obstruction on the landscape they do not provide hiding cover. Within 15 years most of the small diameter trees would be on the ground (see fuels section), and any visual obstruction that had been provided by standing dead trees would be gone.

Cover would be limited to unburned areas. Development of cover would take place over time. Because natural regeneration is generally clumpy there will be cover and forage clumps dispersed within seeding distance of live trees. The interior of the fire may not become forested if seed did not survive the fire and seed trees are not nearby. Modeling of stand characteristics using FVS with natural regeneration of 10 trees per acre per decade at 40 years stands would have crown closures of 4 to 5 percent and average stand diameter of 4 to 6 inches. It is unknown how much hiding cover would be provided by trees or brush. Modeling with FVS indicated it would take 100 years to reach canopy closure in order to provide thermal cover.

Brush would develop where trees do not, providing an abundance of forage. Utilization of the forage may be low due to its distance from cover. Elk use decreases with an increase in distance from the forest edge with most use occurring within 300 yards of the forest edge (Skovlin et al 2002). Deer use decreases similarly with the most use occurring within 200 yards of cover (Thomas et al 1979, Towery 1987).

Alternative B, C, D and E

Direct and Indirect Effects

All action alternatives propose some degree of harvest and planting. Harvest would increase sight distances across the units, increasing big game vulnerability to hunters. Snag clumps, snag retention areas, and topography mitigate this increase in vulnerability to a degree and increase habitat suitability.

Table 3.86 Harvest by Alternative

Action	Alternative B	Alternative C	Alternative D	Alternative E
Commercial Salvage	**6,355**	**6,355**	**1,045**	**3,450**
Logging Systems				
Ground-Based	**3,815**	**3,160**	**850**	**0**
Skyline	**800**	**190**	**195**	**0**
Helicopter	**1,800**	**3,035**	**0**	**3,450**

Use of harvest areas will depend on slash treatments and forage availability. Forage species such as ceanothus and chinquapin have already begun to regenerate since the fire. There would be at least one more growing season prior to any harvest that would allow further development and establishment of shrubs and grasses. Proposed slash treatments would be more intense in ground based units on the flats and base of Hamner Butte and Davis Mountain with grapple piling of fuels less than 12 inches that can be reached from main skid trails with piles burned. Helicopter units would have all stems less than 9 inches felled and only concentrations burned. Alternatives B and C would reduce standing snags, (future debris) over larger areas than D and E.

Harvest and regeneration could reduce the amount of forage in treated units. Forage would be abundant in areas not harvested including 15% leave areas within each unit. Deer and elk use of available forage in untreated areas depend on distribution of cover patches. The amount of tree planting varies with alternatives, by acres of units harvested and acres of regeneration units burned in the fire that are proposed for planting.

Planted acreages are expected to provide hiding cover within 10-20 years. Alternatives B and C would provide the cover throughout the project area. Alternative E provides cover in large patches scattered throughout the project area. Alternative D would provide cover just on the eastern edge of the project area, leaving most of the 100% mortality areas to regenerate naturally. As previously discussed natural regeneration areas may or may not provide hiding cover in the short term, (40 years) or thermal cover over the long run (100 years).

Table 3.87 Reforestation by Alternative

Action	Alternative B	Alternative C	Alternative D	Alternative E
Reforestation	**8,400**	**8,400**	**2,030**	**3,910**

Under all action alternatives, planting trees and bitterbrush will occur on 200 acres within the Key Elk area after two years of monitoring. Frost pockets and a lack of a seed source may prevent establishment of lodgepole pine and bitterbrush within the Key Elk area. Because it is an important area to elk, planting of lodgepole and/or bitterbrush would take place if monitoring shows that natural regeneration is not developing. The units planned for tree planting are strategically place so forage between the units could be effectively utilized.

To minimize disturbance to animals that may be calving near Ranger and Odell Creeks, a seasonal restriction on all harvest activities would be in effect from May 1 through June 30 for those units near riparian areas. (see mitigation measures for list of units).

Cumulative Effects, All Alternatives

The fire burned 13,000 acres of big game cover and 2,300 acres of forage. There is a potential for reduction in deer and elk populations or animal use in this area as a result of a loss of forage and tree cover. Reduction in forage in Yellowstone due to drought, wildfire, and severe winters resulted in high elk calf mortality due to predation. The reduced prey base caused predators to seek out the elk calves, and because fire reduced ground cover elk calves were less likely to hide effectively (Raedek et al 2002). Mortality was also high in adults over the winter due to a loss of winter forage. The Davis Fire was not as extensive as the Yellowstone fires, nor is it winter range, but in the short term it no longer has the capacity of forage and cover that it did before the fire.

The silvicultural treatments planned in the original Seven Buttes Environmental Assessment (USDA 1996) in combination with Seven Buttes Return analysis maintained hiding and thermal cover levels above the Forest Plan minimums of 20 percent in thermal cover and 30 percent in hiding cover stands. The silvicultural treatments were not expected to result in any appreciable change in big game population numbers within this area. Future environmental analysis that may occur in the Seven Buttes area in the next planning cycle 5-10 years from now and would take into consideration the existing condition at that time and the direction provided by the Deschutes National Forest Land and Resource Management Plan.

Across the 6th field watersheds (subwatersheds) cover densities are still high. Animals may be displaced from the fire area until conditions are more favorable.

Table 3.88 Big Game Forage and Cover in 6th Field Watersheds

		Pre-Fire*				Post-Fire			
		Forage		Cover		Forage		Cover	
6th Field Watershed	**Total Forest Acres**	Acres	% of Area	Acres	% of Area	Acres	% of Area	Acres	% of Area
Lower Crescent	9,027	1,466	16%	7,561	84%	1,437	16%	7,475	83%
Middle Crescent	16,200	2,236	14%	13,964	86%	2,199	14%	13,904	86%
Moore Creek	14,512	1,101	8%	13,411	92%	1,028	7%	13,160	91%
Odell Creek	13,655	2,047	15%	11,608	85%	1,521	11%	9,810	72%
Hamner	11,793	1,853	16%	9,940	84%	1,475	13%	7,777	66%
Davis Lake	18,468	1,754	9%	16,714	91%	1,069	6%	11,113	60%
Davis Creek	14,323	1,496	10%	12,827	90%	1,391	10%	11,539	81%
Wickiup	14,181	1,321	9%	12,860	91%	785	6%	10,002	71%
Totals	112,159	13,274	12%	98,885	88%	10,905	10%	84,780	76%

*Seven Buttes and Seven Buttes return activities are included in the before fire totals.

Comparison of Alternatives

The Deschutes LRMP specifies at least 30 percent of each subwatershed should be maintained in hiding cover for the benefit of mule deer and elk populations. With each of the alternatives there is a tradeoff between forage and cover development. While the percent cover across the subwatersheds exceeds forest plan minimums, the opposite is true within the project area.

Table 3.89 Post-fire Cover Distribution in the Project Area

		Forage		Cover		Currently not Habitat	
Big Game Cover	Total Acres	Acres	% of Area	Acres	% of Area	Acres	% of Area
Project Area	21,000	1,305	6%	3,539	17%	16,156	77%

Over time the availability and distribution of cover throughout the project area may influence big game use of the forage. Alternative A has the most forage development with little cover development through reforestation. Alternatives B and C have the most cover development with 8,400 acres of reforestation. Alternative D is similar to Alternative A with treatment and reforestation only along the edge of the fire. Alternative E has scattered blocks of reforestation. See alternative maps.

Table 3.90 Cover Distribution by Watershed Resulting from Reforestation Activities, in Acres

Watershed	Alt. B	Alt. C	Alt. D	Alt. E
Davis Creek	99	99	67	31
Davis Lake	4292	4,292	76	2,096

Lower Crescent	42	42	0	0
Middle Crescent	35	35	0	0
Odell Creek	1,291	1,291	337	840
Wickiup	1,142	1,142	1,118	696
Hamner	1,546	1,546	443	453
Total	8,447	8,447	2,043	4,116

In approximately 10-20 years cover would meet or exceed Forest Plan minimum of 30 percent hiding cover with the implementation of Alternative B, C or E.

Table 3.91 Hiding Cover Development Over Time by Alternative

Alternative	Existing Cover	Developing Cover	Total Cover	% of Area	Existing Forage	Developing Forage	Total Forage	% of Area
Alt. A	3,539	0	3,539	17%	1,305	16,156	17,461	83%
Alt. B	3,539	8,477	12,016	57%	1,305	7,679	8,984	43%
Alt. C	3,539	8,477	12,016	57%	1,305	7,679	8,984	43%
Alt. D	3,539	2,043	5,582	27%	1,305	14,113	15,418	73%
Alt. E	3,539	4,116	7,655	36%	1,305	12,040	13,345	64%

Development of hiding cover within the Key Elk Area is uncertain. All alternatives would be similar if lodgepole pine successfully regenerates naturally across the area. The only planting in the action alternatives that would take place in that scenario would be 45 acres within the Campground buffer and 85 acres of riparian planting of hardwood shrubs and trees. If lodgepole pine does not regenerate to provide cover due to a lack of seed source or due to frost heave, the action alternatives provide for an additional 200 acres of planting.

Table 3.92 Cover Development within the Key Elk Area

Key Elk Area	Existing Cover	Developing Cover	Total Cover	% of Area	Existing Forage	Developing Forage	Total Forage	% of Area
Alternative A	385	0	385	18%	40	1,658	1,698	82%
Alternatives B,C,D,E	385	330	715	34%	40	1,328	1,368	66%

Fisheries

Fisheries Introduction

A Biological Assessment (BA) was prepared to document and review the findings of the Davis Fire Recovery project for potential effects on species that are:

1. listed or proposed for listing by the USDI Fish and Wildlife Service as Threatened or Endangered; or
2. designated by the Pacific Northwest Regional Forester as Sensitive; or
3. required consultation with the National Marine Fisheries Service under the Magnuson-Stevens Fishery Conservation Act. It was prepared in compliance with the requirements of Forest Service Manual (FSM) 2630.3, FSM 2672.4, and the Endangered Species Act of 1973, as amended (Subpart B; 402.12, Section 7 Consultation).

The determination in the Biological Assessment (BA) was that the project would not likely adversely affect (NLAA) bull trout or their habitat, or redband trout and their habitat.

This section describes the existing condition and addresses the potential effects of salvaging timber within the project area on threatened, endangered, and sensitive fish species. This determination, required by the Interagency Cooperation Regulations (Federal Register, January 4, 1978), ensures compliance with the Endangered Species Act (ESA). Changes to the R-6 Regional Forester's Sensitive Species List were instituted on November 28, 2000. Invertebrate species were not included and will not be covered under this section.

A Water Quality Restoration Plan is being developed for the Upper Deschutes River (including Odell Watershed) and Upper Little Deschutes River. The WQRP is scheduled for completion by December of 2004.

Fisheries Existing Conditions

This section provides an overview of the aquatic resources of the Davis Fire Recovery Project area on the Crescent Ranger District of the Deschutes National Forest.

The proposed project area spans across eight sixth field subwatersheds, all within the 2003 Davis Fire burn boundary (see table 3.108). Davis Lake and its tributaries are part of the Odell Lake Bull Trout Recovery Unit. Odell Lake subwatershed does not lie within the project area boundary; however bodies of water within the Odell Lake subwatershed will be discussed throughout the fisheries section. Bull trout are predominately found in Trapper Creek and Odell Lake, which both lie within the Odell Lake subwatershed. Bull trout presence within the eight project area subwatersheds occurs via the Odell Lake subwatershed.

Within the project area, there are three fish-bearing (class 1 or 2) streams and one fish-bearing lake; two of the streams are perennial (table 3.93). Fish species known to currently inhabit lower Odell Creek include: bull trout (*Salvelinus confluentus),* redband trout *(Oncorhynchus mykiss)*, mountain whitefish (*Prosopium Williamsoni), and* brook trout (*Salvelinus fontinalis*). Fish species found upstream in Trapper Creek and Odell Lake include kokanee salmon (*Oncorhynchus nerka*), brook trout (*Salvelinus fontinalis*) and lake trout (*Salvelinus namaycush*). Largemouth bass (*Micropterus salmoides)* and tui chub (*Gila bicolor)* were illegally introduced into Davis Lake at some time in the past century (USFS 1999). Fish species documented in Ranger Creek include: redband trout, brook trout (*Salvelinus fontinalis)*, mountain whitefish, tui chub, and Atlantic salmon (*Salmo salar)* introduced by ODFW in 1988 (USFS stream surveys 1990, 1995). Moore Creek is inhabited by rainbow trout *Oncorhynchus mykiss* and brook trout upstream of the project area, where the stream is perennial (Weiss personal communication). Rainbow and brook trout have been stocked in Bobby Lake, which Moore Creek flows out of. Historically bull trout inhabited Davis Lake though they have not been documented in the lower reach of Odell Creek since 1979 (USFS 1999; Goetz 1991). Bull trout have been recently documented in upper Odell Creek, near the outlet of Odell Lake, which is outside the burn area of the Davis Fire. It is believed that bull trout may use Odell Creek for foraging and possible spawning in cold-water tributaries (USFS 1999). Redband trout are the dominant fish species in Odell and Ranger Creeks. The Columbia River populations of bull trout (*Salvelinus confluentus*) were listed as a

threatened species by the U.S. Fish and Wildlife Service under the Endangered Species Act on June 10, 1998 (63 FR 31647). Redband trout are on the Regional Forester's sensitive species list (table 3.93). Populations of redband trout and mountain whitefish are strong within Odell Creek. A majority of this section will focus on effects to bull trout as they are a more imperiled population and more sensitive to environmental degradation.

Table 3.93 Bodies of Water within the Davis Fire Recovery Project Area and Fish Species Utilizing Them

Body of Water	Subwatershed	Species (Status)
Davis Lake	170703010204 - Davis Lake	Largemouth Bass
		Tui Chub
		Redband Trout *(Sensitive)*
Odell Creek (perennial)	170703010202 – Odell Creek	Redband Trout *(Sensitive)*
		Bull Trout *(Threatened)*
		Mountain Whitefish
Ranger Creek (perennial)	170703010204 – Davis Lake	Redband Trout *(Sensitive)*
		Tui Chub
		Brook Trout
		Mountain Whitefish
		Atlantic Salmon
Moore Creek (intermittent)	170703010203 – Moore Creek	N/A

Odell Creek flows out a glacial moraine on the eastern border of Odell Lake. Approximately 52 cfs in Odell Creek is contributed by spring fed tributaries (Odell Creek discharge data 1936-1976). Odell Lake contains the last natural adfluvial population of bull trout in the state of Oregon (USFS 1999).

Crescent Creek lies outside of the project area boundaries; however, a portion of the Middle and Lower Crescent Creek subwatersheds, which drain subsurface to Crescent Creek lie within the project boundary. Project activities within this subwatershed are limited to the upper slopes of Hamner Butte and lie more than 3.2 miles (direct line) from Crescent Creek (the nearest perennial stream). Unit #30 within the Middle Crescent Creek Watershed is on the summit of Hamner Butte on the south side, this unit lies 3. 2 miles as the crow flies from Crescent Creek. Unit #160 is also on the summit of Hamner Butte to the south and east and lies within the Lower Crescent Creek subwatershed, this unit is 3.3 miles from Crescent Creek as the crow flies. Crescent Creek is listed on the State of Oregon's 303(d) Water Quality Limited Streams list for exceeding summer rearing temperatures.

Historically bull trout inhabited Crescent Creek, but the species is believed to have been extirpated from the watershed following the construction of an impassable dam at Crescent Lake. Fish species known to currently inhabit Crescent Creek include rainbow or redband trout, brook trout and brown trout.

Habitat Description

Natural, Physical, and Biological Character

The Little Deschutes and Upper Deschutes 4th field watersheds are part of the High Cascades Ecoregion and consist of basalt, andesite and basaltic eruptive complexes that form large, overlapping shield volcanoes. The parent materials for the dominant soil types in this watershed are the air fall pumice and ash from the Mount Mazama eruption approximately 7,000 years ago. The glaciated portions of the watershed have fine sandy loam textured soils over compacted ground moraines. The subbasin is composed primarily of older glacial outwash that affects the character of water transport and plant growth in the area. Recreational activities have concentrated around water and riparian areas. Riparian vegetation has been negatively impacted as a result of compacted soils and erosion.

Odell Creek flows 7.5 miles from Odell Lake to Davis Lake. Maklaks Creek and two other spring-fed tributaries feed into Odell Creek and contribute approximately 50% of the flow during summer months (Dachtler 1998). Odell Creek is a low gradient stream, about 0.6% from the mouth to the confluence with Maklaks Creek and then increases to approximately 1.2% to the outlet at Odell Lake. Most of Odell Creek is characteristic of a Rosgen C3 or C4 type channel (cobble/gravel dominated with less than 2% average slope, sinuosity greater than 1.4, entrenchment of 1.4 to 2.2 and a bankfull width to depth ratio of greater than 12).

Lodgepole pine encroachment along Odell Creek, the lower two miles in particular, has likely had a negative effect on water temperatures during summer months (Odell WA, p 146). The once wet meadow has transitioned from a riparian dependant, sedge/shrub dominated flat to a dry lodgepole pine flat. Lodgepole encroachment has been facilitated by fire exclusion, stream cleanouts (removing woody debris from the channel), and from the reduction in beaver activity. These three factors have been paramount in lowering the water table to the point that lodgepole pine trees could out compete riparian dependant native sedges and shrubs. Riparian shrubs such as willow help reduce the effects of warming due to solar radiation by providing shade and bank stability. The broad, bushy shape of these shrubs can provide more shade to a small stream channel than the tall, spindly lodgepole can. Riparian-dependant sedges and shrubs also provide bank stability, maintaining a relatively deep and narrow low flow stream channel, thus reducing the surface area of water exposed to the warming effects of solar radiation.

Although riparian dependant species are more able to sufficiently cool stream temperatures than the encroaching lodgepole, the lodgepole themselves are not the real problem, but rather a symptom of the problem. The real issue is the conditions that have led to the encroachment of these conifers. Fire exclusion and a lowered water table have allowed this transformation to occur. The lowered water table is probably the most significant factor influencing stream temperature within this reach. With a restored, elevated water table, cool subsurface water contributes to the cooling of surface water during summer months. The elevated water table also promotes the recovery of riparian dependant species rather than conifer species that typically prefer drier soils. Recovery of the water table can be accomplished through the addition of instream logjams, planting native shrubs, and restoring beavers as a major component of structure maintenance.

Ranger Creek is a small, spring-fed stream, which flows 1.5 miles at about 3 cubic feet per second during summer low flow periods (USFS stream survey 1990). The last habitat assessment of Ranger Creek was completed in 1995, which found high densities of small in-channel wood (27 pieces per mile >12” and 904 per mile <12”) and overhead cover to be low. Stream cover was estimated to be between 5 and 20% in the forested reach and non-existent in the lower 0.8 miles from the tree line to the lakeshore. Pools are infrequent and generally developed either behind beaver complexes or logjams. The most abundant habitat type is glides, which make up 67% of the habitat in reach 1. The general substrate in Ranger Creek is sand and gravel sized material (USFS stream survey 1995).

Moore Creek is an intermittent stream that flows 8.6 miles from Bobby Lake to Davis Lake. The lower 0.54 miles lie within the Davis Fire burn perimeter. Moore Creek is perennial in the upper reach and is inhabited by rainbow trout *Oncorhynchus mykiss* and brook trout. Fish use of lower Moore Creek is unknown; it is possible that redband trout move into this stream segment during adequate flows; however this has not been documented.

Davis Lake was created approximately 5,500 years ago by a lava flow that dammed Odell Creek. There is no surface outflow from this impoundment. Water seepage and surface evapotranspiration account for the loss of water from this shallow lake. Seepage rates are estimated to be approximately 150 cfs on average, with more seepage occurring during periods of elevated lake levels (Phillips 1968). Previous studies have not been able to

definitively identify where seepage water from Davis Lake goes, although it is believed and likely that water is delivered to Wickiup Reservoir through subsurface spring flows (McCammon 1982). Lake elevations have fluctuated from an estimated elevation of 4395.4 before 1728 to a low of 4376.1 in 1941 (Phillips 1968). During the 1980s the low lake surface level ranged in elevation from 4389 in 1984 to 4379 in 1988, a difference of 10 feet within four years (Lake Elevation Graph). Lake elevations are a direct reflection of precipitation for the year; during low water or drought years the lake is low and the lake is high during high water years (Phillips 1968).

Table 3.94 Rosgen Stream Class Type by Reach for Streams within the Project Area

Subwatershed	Stream Name	Rosgen Channel Type
170703010202 Odell Creek	Odell Creek (Reach 1)	C4
170703010202 Odell Creek	Odell Creek (Reach 2)	C3/4
170703010202 Odell Creek	Odell Creek (Reach 3)	B3
170703010204 Davis Lake	Ranger Creek	C3
170703010203 Moore Creek	Moore Creek	C3

Crescent Creek flows from Crescent Lake for approximately 26 miles before entering the Little Deschutes River near the town of Gilchrist, Oregon. Crescent Lake was a natural, glacially carved lake, which was modified with a dam structure in 1922 to increase the storage capacity for irrigation purposes. The dam was reconstructed in 1955-56 to restore the storage capacity of the project and replace the original timber-crib dam structure with concrete. The dam structure is 40 feet tall and does not allow for fish passage (Bureau of Reclamation 2004). Bull trout that once inhabited this lake are presumed to have since gone extinct. The two main tributaries to Crescent Creek are Big Marsh Creek and Cold Creek.

A dam is operated at the outlet of Crescent Lake by the Tumalo Irrigation District. Irrigation water is stored in Crescent Lake through the winter months and released in the summer. Fish passage is nonexistent at this site. Flow in Crescent Creek is highly modified below the dam structure. Winter flows from the dam to the confluence with Big Marsh Creek are often in the range of 3 to 9 cfs, while summer discharge averages about 120 cfs (Bureau of Reclamation 2004). Flow regulation at Crescent Lake Dam is probably the greatest limiting factor affecting fish habitat. Because of flow modifications, the natural hydrograph of Crescent Creek has changed to low flows prevalent between September and April during reservoir storage months and high flows during the rest of the year.

From the dam at Crescent Lake to the intersection with County Road 61, Crescent Creek is part of the National Wild and Scenic Rivers System. The large ponderosa pine trees and the narrow canyon adjacent to Odell Butte have contributed to the determination that vegetation and scenery are the Outstanding Remarkable Values (ORV) for this river segment. The Wild and Scenic Rivers Act requires that these and other river-related values be protected and enhanced. The Deschutes National Forest Land and Resource Management Plan requires that harvest of trees will be oriented towards enhancement of scenic, hydrologic, fisheries, recreational, and/or wildlife values. The interim Wild and Scenic river buffer corridor is ¼ mile (1320 feet) on either side of the stream. The standards and guidelines in the Forest Plan will serve as an interim management direction until formal river corridor management plans are completed and the Forest Plan is amended to include the appropriate direction.

Crescent Creek was surveyed using Region Six stream protocol (USFS 1988) in 1990 (Houslet and Hollister 1990) and 1992 (anonymous) from County Road 61 to the outlet of Crescent Lake. A more recent survey of the stream was completed from the private/FS boundary near the 61 road to Highway 58 bridge and from the private property boundary to the dam at Crescent Lake during the summer and fall of 2000 (Dachtler 2001).

The substrate of Crescent Creek between County road 61 and Highway 58 is dominated by small boulders, and to a lesser extent with cobble and large boulder. Gradient in this section averages 3%, and is confined by a steep canyon. Large and small boulders provide primary instream cover in this section with small woody debris being secondary. Upstream of Highway 58, the gradient of Crescent Creek decreases and the valley floor widens in this 7.5-mile reach. The stream channel gradient averages between 1 and 2%. Numerous backwater and side

channel areas are in this section. Habitat distribution has a fairly even balance between pools, rifles, and glides. Instream cover consists of undercut banks, wood and turbulence.

Native fish species known to have existed in Crescent Creek include bull trout, redband trout, mountain whitefish and reticulate sculpin (*Cottus*) (Fies et al. 1996). A fish survey performed below Highway 58 by ODFW in 1992 found that although rainbow trout were the most abundant trout species in this section of Crescent Creek the density was lower than expected (Fies et al. 1996). Bull trout have been extirpated from the Crescent Lake/ Creek system.

Crescent Creek has been proposed as Core area habitat in the final draft Bull Trout Recovery Plan (USFWS 2002). Core area habitat extends from Whitefish Creek headwaters through Crescent Lake and Crescent Creek to the Confluence with the Little Deschutes River. The Little Deschutes River upstream to its headwaters has also been proposed. Tributaries to Crescent Creek, Cold Creek, Big Marsh Creek and Refrigerator Creek have also been proposed as Core Area bull trout habitat (USFWS 2002).

Wickiup Reservoir lies to the north of the Davis Fire Recovery Project. The Wickiup and Davis Creek subwatersheds lay within the project are and drain to Wickiup Reservoir. Within the Wickiup watershed, surface and ground water generally originate in the high precipitation areas to the west and drain to Wickiup Reservoir. The Deschutes River flows down from Crane Prairie Reservoir to Wickiup Reservoir and is listed on the state of Oregon's 303 (d) list of water quality impaired streams. The Deschutes River is listed for high summer water temperatures.

Fish populations are predominantly non-native game species introduced by ODFW and in some cases illegally by the public. Native species are limited to mountain whitefish, sculpin, and redband trout, which have some genetic mixing with stocked rainbow trout. Historically, bull trout inhabited the area, but have since become extirpated. A variety of factors such as overfishing, interspecific competition, habitat degradation and lack of fish passage at Wickiup and Crane Prairie Dams are thought to have led to the elimination of bull trout from this area (Walker 2001).

Illegal introductions into Wickiup Reservoir include brown bullhead, tui chub, three-spined stickleback, largemouth bass, black crappie and bluegill. Species introduced by ODFW include rainbow trout, kokanee salmon, coho salmon, brown trout and brook trout. There are no anadromous species and no Essential Fish Habitat in the area (Walker 2001).

The Charlie Brown silviculture project has been implemented by the Bend/Fort Rock Ranger District of the Deschutes National Forest to the north of the Davis Fire Recovery Project. The Charlie Brown project used a combination of silvicultural activities, road closures, road obliterations, restoration of dispersed recreation sites and fuels treatments to restore watershed conditions, function and diversity (Walker 2001).

Three fuels treatment units lie within the Wickiup and Davis Creek subwatersheds, which also have proposed units in the Davis Fire Recovery Project. The three Charlie Brown units are partially within Riparian Reserves (RR) or Riparian Habitat Conservation Areas (RHCA). A total of 49 acres of fuels treatments occurred within the RR or RHCA of Wickiup Reservoir. These units were implemented to achieve ACS objectives with the long term goal of improving riparian conditions and stand health (Walker 2001).

As there are no streams within the Wickiup or Davis Creek subwatersheds that could possibly transport sediment from project areas to Wickiup reservoir, this water body will not be further discussed or analyzed throughout this report. Project activities would in no way inhibit large wood recruitment, introduce sediment or increase water temperatures in Wickiup Reservoir.

Bull Trout Status, Distribution, and Habitat

The Columbia River populations of bull trout (*Salvelinus confluentus*) were listed as a threatened species by the U.S. Fish and Wildlife Service under the Endangered Species Act on June 10, 1998 (63 FR 31647). The USFWS, ODFW, and Forest Service have developed a recovery plan which addresses limiting factors for the Odell Lake Recovery Unit. Within the recovery unit, historical and current land use activities have impacted bull trout local populations. Limiting factors include competition with other fish species for resources, hybridization with brook trout, limited spawning and rearing habitat in the tributaries of Odell Lake, partial barriers created at railroad or

road crossings, and habitat degradation due to large woody debris removal, intentional channelization of streams, and loss of riparian cover. Odell Creek has been added as Critical Habitat for Bull Trout recovery by the USFWS.

The goal for bull trout recovery is to ensure the long-term persistence of self-sustaining complex, interacting groups of bull trout distributed across the species' native range, so that the species can be delisted. To accomplish this goal the following four objectives were identified for bull trout in the Odell Lake Recovery Unit:

1. Maintain the current distribution of bull trout and restore distribution in previously occupied habitats within the Odell Lake Recovery Unit.
2. Establish an increasing trend in abundance of adult bull trout.
3. Restore and maintain suitable habitat conditions for all bull trout life history stages and forms.
4. Conserve genetic diversity and provide opportunity for genetic exchange. (USFWS 2003)

The Odell Lake Recovery Unit encompasses an area of approximately 302 square kilometers. It is located within the Deschutes National Forest in Deschutes and Klamath Counties, Oregon. The Odell Lake Recovery Unit consists of Odell and Davis Lakes, Odell Creek, which flows from Odell Lake to Davis Lake, and all tributaries. The two lakes were isolated from the Deschutes River by a lava flow about 5,500 years ago that impounded Odell Creek and formed Davis Lake. The lava flow isolated bull trout in Odell Lake from bull trout in the rest of the upper Deschutes Basin. Odell Lake bull trout are the only remaining natural adfluvial population of bull trout in Oregon. Currently, bull trout are spawning in only one tributary to Odell Lake (Trapper Creek), indicating that there is one population of bull trout in the Recovery Unit. The estimated abundance of adult spawners is less than 100 (U.S. Fish and Wildlife Service 2003).

The Odell Lake bull trout working group was established in the early 1990's for the purpose of determining the status of bull trout in Odell Lake. The formation of the working group originally consisted almost totally of area biologists from ODFW and the USFS. It was expanded to include other interests in 1996 and to develop a conservation strategy for Odell Lake bull trout. The Odell Lake bull trout working group became the Recovery Unit Team when bull trout were listed in 1998. The U.S. Fish and Wildlife Service completed the Recovery Plan in 2003 (U.S. Fish and Wildlife Service 2003).

The draft recovery plan developed for the Odell Recovery Unit identifies forest recreation (particularly along Trapper Creek) and past stream alterations to Trapper Creek (railroad and road crossings, berming, cleanouts, etc.) as the forest management practices (past or present), which pose a threat to bull trout.

A two-phase stream rehabilitation project has been implemented along the lower 0.5 miles of Trapper Creek. Trapper Creek is the highest priority stream in the Odell Recovery Unit as all known spawning and nearly all known rearing occurs within the lower 0.6 miles of this stream. Trapper Creek is critical to the survival of the bull trout population in the Odell watershed. An additional project will be implemented in the fall of 2004 to add approximately 40 large trees and increase cover and habitat diversity.

The two phases of stream restoration occurred on two different stream types. Phase 1 was implemented in 2002 on a Rosgen B3 stream type (gradient greater than 2%, slightly entrenched with low sinuosity). Phase II was implemented along a Rosgen C4 channel type (<2% slope, bankfull width/depth ratio >12 and a sinuosity of over 1.2). The following tables summarize the changes to stream pattern and profile and changes to bull trout habitat.

Table 3.95 Changes in Trapper Creek Channel Pattern and Profile Following Rehabilitation

Variables	Phase 1		Phase II	
	1998	2003	1998	2003
Stream Type	B3 Incised	$C3_b$	F4/C4 Incised	C4
Bankfull Width	50	33	42	32
Mean Bankfull Depth	1.5	2	1.7	2
Bankfull Width/Depth	35	16	25	16

Ratio				
Bankfull Max Depth	<2	2.6	<2	2.6
Width of Floodprone Area	72	131	51	128
Entrenchment Ratio	1.5	4	1.2	4
Radius of Curvature	138	112	56	70

Table 3.96 Changes to Bull Trout Habitat in Trapper Creek Following Rehabilitation Efforts

Habitat Type	Phase 1		Phase II	
	1998	2003	1998	2003
Med/Large Wood per Mile	7	7	9	104
Side Channel Area ft^2	No Data	1415	0	2460
% Pool	22	43	43	58
% Good/Fair Spawning	2	17	5	21
% Good/Fair Rearing	0.4	8.4	6	24

These recovery efforts have been very successful in stabilizing the stream hydrology and reducing peak discharge energies and erosion as well as increasing high quality bull trout habitat in the form of quality pools, off channel habitat, cover and large wood complexity.

A stream rehabilitation project will be implemented during the summer of 2004 to improve hydrologic function and improve bull trout habitat within the lower reach of Odell Creek. This project will involve placement of more than 150 trees within a 1.5 mile project reach into logjam structures. These structures will reduce peak discharge energies, increase pool habitat and cover and stabilize stream banks, reduce sediment delivery and increase floodplain connectivity.

In addition to the instream work, ODFW has adopted changes in angling regulations to prohibit take of bull trout and modified regulations on other fisheries (lake trout) to reduce incidental take.

Trapper Creek has been closed to all angling since 1993. In 1997, ODFW adopted regulation to close Odell Lake to angling within 200 feet of the mouth of Trapper Creek from September 1 to October 31. Beginning in 2000, this regulation was extended to a year round closure. Angling in Odell Creek and Davis Lake is limited to barbless flies. ODFW partners with the USFS to remove brook trout from Trapper Creek annually and bass from Davis Lake.

As of 2000, stocking by ODFW was discontinued in Odell and Davis Lakes. Brook trout are no longer stocked in the high lakes of the Odell Lake watershed (Draft Odell Lake Bull Trout Recovery Plan).

Population Trends

The Odell Lake Bull Trout Working Group (a group of State and Federal partners responsible for the recovery of bull trout) is developing and implementing rehabilitation projects and performing monitoring to assess the population size and distribution and plans to continue ongoing activities such as snorkeling, creel surveys, and adult spawning surveys. Odell Lake has the only remaining natural adfluvial population of bull trout in the state of Oregon. Snorkeling surveys have been conducted in Trapper Creek, annually since 1996. Results from those surveys are listed below in the Description of Ratings of Baseline Indicators section.

Lake trout (*Salvelinus namaycush*), Eastern brook trout (*Salvelinus fontinalis*) and kokanee salmon (*Oncorhynchus nerka*) compete with bull trout for food, as well as rearing and spawning habitat. Donald and Alger (1992) documented lake systems where lake trout decimated bull trout populations. Expansion of brook trout and other species into bull trout habitats can lead to greater isolation (Leary, 1993) and hybridization.

Bull trout are occasionally observed in Odell Creek. Satterthwaite (1979) observed various age classes of bull trout while snorkeling the length of Odell Creek. An adult bull trout was sighted in Odell Creek on 11/1/98 about 100 yards below the outlet of Odell Lake (Dachtler 1998). Anglers reportedly caught two bull trout in this system in 1989 (Dachtler personal communication). Five juvenile bull trout were observed in Odell and Maklaks Creeks and an unnamed tributary to Odell Creek during exploratory surveys in 2003. Snorkel surveys conducted in the spring of 2004 found an additional two juvenile bull trout in lower Odell Creek.

The estimated abundance of adult bull trout spawners is less than 100 (USFWS 2003). Historical abundance of bull trout in this watershed is somewhat anecdotal, however it is believed that there has been a decrease in the population over the past century. An Oregon State Game Commission (OSGC) report from 1948 states that excellent fishing was enjoyed during the year; the fishery was supported mainly by blueback salmon (kokanee) and Dolly Varden (bull trout). The same report goes on to say that there was a large population of forage fish including whitefish and large Dolly Varden. An OSGC report from 1946 states that Dolly Vardens are in abundance and provide good fishing for trollers early in the season. This same report goes on to suggest that trapping and removing Dolly Varden from their spawning runs would be desirable to reduce the predation of blueback salmon.

Redband trout are thriving within the Odell watershed. Snorkel surveys conducted in Trapper and Odell Creeks have documented an abundance of these fish. A survey conducted in June of 2004 along less than 1 mile of lower Odell Creek documented 217 redband trout greater than eight inches in length. Numerous smaller redband were observed and not counted due to the abundance of the fish.

Red surveys conducted in the spring of each year regularly document a high density of redband trout redds, particularly along lower Odell Creek. Redd counts average around 250 redds per year.

Redband trout are present but at depleted levels within Crescent Creek. The native redband population has likely been negatively affected by the introduction of brook and brown trout, flow modifications and the passage barrier at Crescent Dam.

Habitat Condition and Trends

Spawning

The only known active bull trout spawning area for the Odell Lake population is from the mouth of Trapper Creek to a 7.6-foot falls inside the Diamond Peak Wilderness (0.66 miles) at the “top” of the watershed. Trapper Creek is a tributary to Odell Lake and lies more than 11 miles upstream of the Davis Fire area. Redband trout spawn throughout Odell Creek, with heavy activity in the lower reach. Cy Bingham, an early Forest Service Ranger and an Oregon State Game Commission report from 1948 identify Crystal Creek (Odell Lake tributary) as a most significant bull trout spawning area. No bull trout have been documented in Crystal Creek for several decades.

Redband trout spawn heavily in the lower reaches of Odell Creek. The number of observed redds typically correlates strongly to the availability of water for that year. Meaning, high water years tend to have higher redd counts. It should be noted that in the table below, the 2004 data only depicts ½ of the usual survey area. Typically the redd survey is conducted from the snowmobile bridge at approximate river-mile 3.9 to the mouth. Surveys conducted in 2004 were from the 4660 road (approximate river-mile 2.0) to the mouth.

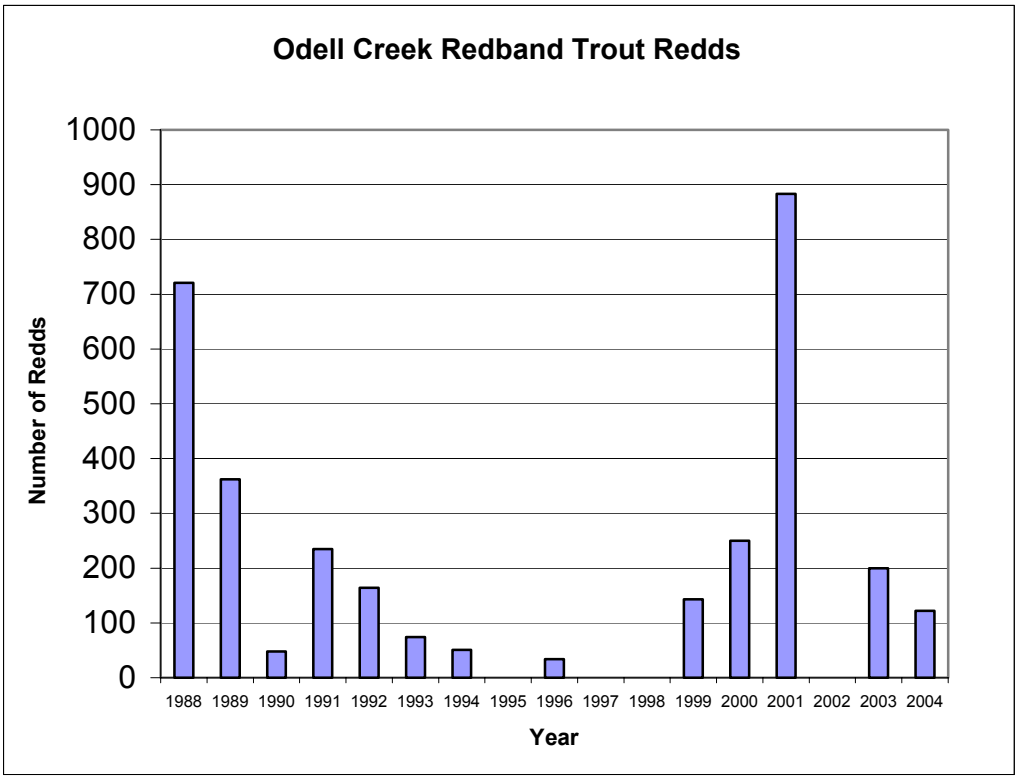


Figure 3.25 Number of Observed Redband Redds in Odell Creek (Wise, ODFW 2004)

Redd surveys have not been conducted for any other species.

Rearing

During 2003 exploratory surveys, juvenile bull trout were found in mid to upper Odell Creek, Maklaks Creek and an unnamed tributary immediately upstream of Maklaks Creek. Odell Creek is mainly comprised of several hundred foot long riffles through this reach, with a few deep pools separating them. Lower Odell Creek provides more suitable rearing habitat as the stream gradient and temperatures are reduced and habitat diversity is increased. Debris jams and off channel habitat are more common features of lower Odell Creek. Redband trout in Davis Lake utilize the lower reach of Odell Creek as a cool water refuge in late summer when water levels are low and temperatures are high in Davis Lake (Weiss personal communication). Saitterwaite observed Bull trout at various life stages in this lower reach of Odell Creek in 1979. Most known rearing occurs in Trapper Creek.

Adult redband trout are commonly found in Davis and Odell Lakes as well as Odell Creek. Snorkeling and other fish sampling efforts have documented individual fish in Crystal, Trapper, and Maklaks Creeks. Crystal and Trapper Creeks are each tributaries to Odell Lake.

The Odell Creek population of redband trout appears to be healthy and stable. Snorkel surveys of the stream channel have documented hundreds of redband trout throughout the stream channel. Spawning surveys conducted in the spring months regularly identify significant redd production within the lower four miles of stream channel.

Description of Ratings of Baseline Indicators for the Odell Lake Subwatershed and Effects of the Alternatives

Table 3.116 displays ratings of relevant indicators for the Odell Lake Subwatershed. The Odell Lake Subwatershed is analyzed because it is a bull trout watershed and considered Critical Habitat. Following the table, each indicator

is discussed separately, including the effects of each alternative. Some of these indicators are also included in the Water Quality and/or Soils sections.

Table 3.97 Environmental Baseline of Relevant Indicators, Odell Lake Subwatershed for Bull Trout

	Diagnostics/ Pathways	Population and Environmental Baseline		
	Indicators	Functioning Appropriately	Functioning at Risk	Functioning at Unacceptable Risk
SPECIES	Subpopulation Size			X
	Growth and Survival			X
	Life History Diversity and Isolation			X
	Persistence and Genetic Integrity			X
HABITAT	Water Temperature			X
	Sediment	X		
	Chem/nutrients		X	
HABITAT ACCESS	Physical Barriers		X	
HABITAT ELEMENTS	Substrate Embeddedness			
	Large Woody Debris		X	
	Pool Frequency and Quality		X	
	Large Pools		X	
	Off Channel Habitat		X	
	Refugia		X	
CHANNEL CONDITIONS AND DYNAMICS	Wetted Width/Max Depth Ratio		X	
	Streambank Condition	X		
	Floodplain Connectivity		X	
FLOW/HYDROLOGY	Change in Peak/base flows		X	
	Drainage Network Increase		X	
WATERSHED CONDITIONS	Road Density and Location		X	
	Disturbance History			
	Riparian Conservation Areas		X	
	Disturbance Regime		X	
Integration of Species and Habitat Conditions				**X**

HABITAT

Odell Creek:

Reach 1: River Mile 0.0 to 1.7, first campsite on left upon entering Davis Lake Campground to Road 4660 crossing (reach within the Davis Fire perimeter).

Reach 2: River Mile 1.7 to 3.9, road 4660 crossing to the confluence with Maklaks Creek.

Reach 3: River Mile 3.9 to 7.5, confluence with Maklaks Creek to the outlet of Odell Lake.

The Davis Fire of 2003 was responsible for significant changes to the eight subwatersheds within this project area. However, given the highly porous soils, the generally flat topography of the valley bottom and the

absence of any streams flowing through a majority of the burn area, the BAER Team (Burned Area Emergency Rehabilitation) recommended only photo monitoring and field visits during storm events to protect area waterways from damage as a result of the fire.

Water Temperature

Water temperatures recorded in Odell Creek during the summer of 1998 averaged 17.6°C at the outlet of Odell Lake/origin of Odell Creek. Maximum water temperatures exceed 25°C during the months of July and August. Tributaries such as Maklaks Creek, and a few other small springs contribute water that averages 4°C during summer months. The cooling effect of these springs reduces the temperature of Odell Creek to an average of 11.6°C by the time it reaches Davis Lake (Dachtler, 98). A small rock weir constructed during summer months at the outlet of Odell Lake may contribute to increased water temperatures in Odell Creek as additional lake surface water is stored and exposed to increased solar radiation in Odell Lake.

Temperature monitoring probes have been deployed upstream of the burn area on Odell Creek and through the burn area. Results from these probes are not yet available as the probes are being left in channel to monitor temperatures throughout the summer.

Table 3.98 Maximum, Minimum, and Mean 1998 Summer Temperatures near the Outlet of Odell Lake (Upper) and at the Footbridge above Davis Lake (Lower)[6]

Temperature Type	Outlet of Odell Lake º C	Near inlet to Davis Lake º C
Maximum	25.2	20.2
Minimum	11.4	5
Mean	17.6	11.6

Crescent Creek originates as surface water from Crescent Lake and therefore begins its journey as a warm body of water during summer months. As the chart below shows, Crescent Creek continues a general warming trend until about river mile 19 at which point it begins to cool very slightly.

[6] Odell Creek is 303(d) listed for water quality impairment. Specifically, temperature parameters are 17.8 C for bull trout rearing in the summer and 12.8 for spawning during the rest of the year.

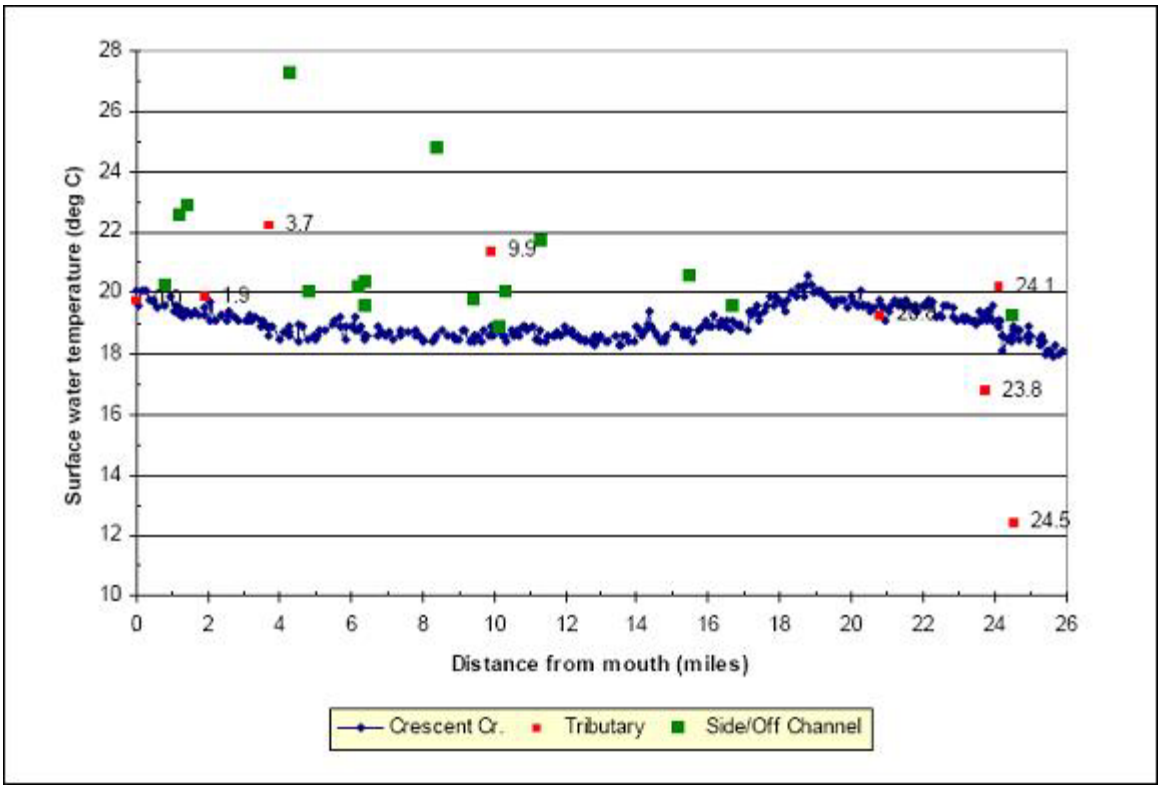


Figure 3.26 Median Channel Temperature Versus River Mile for Crescent Creek with Tributaries Denoted with Red Dots and Side Channels Denoted by Green Dots. Direction of Flow is from Right to Left.

Table 3.99 Tributary and Side Channel Influences on the Temperature of Crescent Creek

correspond to data levels shown in Figure 11.

Tribuary Name	Image	km	mile	Tributary Temp °C	Crescent Cr. Temp °C	Difference
Little Deschutes (RB)	cres0008	0.0	0.0	19.8	19.8	0.0
No Name (LB)	cres0075	3.0	1.9	19.9	19.3	0.6
No Name (LB)	cres0140	6.0	3.7	22.3	18.6	3.7
No Name (LB)	cres0326	15.9	9.9	21.4	18.9	2.5
Big Marsh Cr. (RB)	cres0762	33.5	20.8	19.3	19.8	-0.5
No Name (RB)	cres0896	38.2	23.8	16.8	19.2	-2.4
No Name (RB)	cres0932	38.8	24.1	20.2	18.9	1.3
Cold Spring Cr. (LB)	cres0960	39.4	24.5	12.4	18.9	-6.5
Side/Off Channel						
Side Channel (RB)	cres0039	1.3	0.8	20.3	19.6	0.7
Off Channel (LB)	cres0053	2.0	1.2	22.6	19.3	3.3
Off Channel (RB)	cres0062	2.3	1.4	22.9	19.4	3.5
Off Channel (LB)	cres0153	6.9	4.3	27.3	18.9	8.4
Side Channel (RB)	cres0166	7.7	4.8	20.1	18.5	1.6
Side Channel (LB)	cres0213	10.0	6.2	20.2	18.8	1.4
Off Channel (RB)	cres0219	10.3	6.4	20.4	18.6	1.8
Off Channel (LB)	cres0220	10.3	6.4	19.6	18.5	1.1
Off Channel (LB)	cres0273	13.5	8.4	24.8	18.6	6.2
Side Channel (LB)	cres0308	15.2	9.5	19.8	18.4	1.4
Side Channel (LB)	cres0333	16.3	10.1	18.9	18.8	0.1
Side Channel (RB)	cres0341	16.6	10.3	20.1	18.4	1.7
Side Channel (RB)	cres0372	18.1	11.3	21.8	18.8	3.0
Side Channel (RB)	cres0548	24.9	15.5	20.6	18.8	1.8
Side Channel (LB)	cres0591	26.8	16.7	19.6	19.1	0.5
Side Channel (RB)	cres0958	39.4	24.5	19.3	18.6	0.7

Water temperatures recorded in Ranger Creek during the summer of 1995 show stream temperatures at 4.8°C near the headwaters but as high as 13°C in the beaver jam pools (USFS 1990, 1995).

No temperature data is available for Moore Creek as it only flows for a couple of months at most during any given year. This lower stream segment is dry during summer months.

Davis Lake is shallow with a large surface area; therefore it heats up rather quickly as the result of solar radiation during the day and then quickly cools at night. Davis Lake is typically in the 20°C to 25°C range during the day in summer months and around 16°C at night. The temperature can change very quickly, for example on September 30, 1995 at 4:55 am the temperature was 10°C (50 °F), by 11:19 that morning the temperature had risen to 22.4°C (72.3 °F) (1995 temperature data).

Direct and Indirect Effects

Alternative A

Stream temperature would be expected to increase slightly in Odell Creek and possibly Ranger Creek under the no action alternative in the short term (0-5 years) as a result of the fire, and then decrease after that. On Odell Creek, within the project boundary approximately 35% of stream shade has been lost due to the fire mortality of the riparian trees (Davis Rapid Assessment, 2003). Increased solar radiation will reach surface water and

cause slightly higher stream temperatures until natural regeneration of riparian shrubs (willow, alder, etc) can occur. Once these plants are established, the large bushy shape and high leaf density may provide more shade than during pre-fire conditions.

Likewise Ranger Creek has lost a shade source for the upper reach in the short-term; however, once riparian shrubs become re-established, shade should be increased. Stream temperature increases in Ranger Creek may be slight as the stream is spring fed and only flows for about 1.5 miles before entering Davis Lake, much of which flows through the dry lakebed of Davis Lake, outside the timberline. Therefore there is a relatively small increase in direct solar radiation.

Davis Lake may exhibit very slight increases in temperature as its two tributaries may warm very slightly in the short term. However, influence from stream flows is not expected as the high surface area of Davis Lake relative to its volume is what influences temperature the most. Davis Lake gets hot during the day when the sun is shinning on it and the air is warm and then it cools rapidly at night, when the air is cool.

Moore Creek should not experience increased temps as the stream channel within the burn perimeter is dry during summer months.

Alternatives B, C, D, and E

Stream temperature would be expected to increase slightly in Odell Creek and possibly Ranger Creek in the short term (0-5 years) as a result of the fire, and then decrease after that. On Odell Creek, within the project boundary approximately 35% of stream shade has been lost due to the fire mortality of the riparian trees (Davis Rapid Assessment, 2003). Increased solar radiation will reach surface water and likely cause slightly higher stream temperatures until riparian shrubs (willow, alder, etc) become established. Natural regeneration as well as supplemental planting of these species would occur. Presumably stream shade would be recovered more quickly and in greater abundance as the result of planting. Once these plants are established, the large bushy shape and high leaf density may provide more shade than during pre-fire conditions.

Likewise Ranger Creek has lost a shade source for the upper reach in the short term, however, once riparian shrubs become re-established shade should be increased. Stream temperature increases in Ranger Creek may be slight as the stream is spring fed and only flows for about 1.5 miles before entering Davis Lake, much of which flows through the dry lakebed of Davis Lake, outside the timberline.

Davis Lake may exhibit very slight increases in temperature as its two tributaries may warm very slightly in the short term. However, influence from stream flows is not expected as the high surface area of Davis Lake relative to its volume is what influences temperature the most. Davis Lake gets hot during the day when the sun is shinning on it and the air is warm and then it cools significantly at night, when the air is cool.

Moore Creek should not experience increased temps as the stream channel within the burn perimeter is dry during summer months.

Cumulative Effects

All Alternatives

Lodgepole pine encroachment along Odell Creek, the lower two miles in particular, has likely had a negative effect on water temperatures during summer months (Odell WA, p 146). The once wet meadow has transitioned from a riparian dependant, sedge/shrub dominated flat to a dry lodgepole pine flat. Lodgepole encroachment has been facilitated by fire exclusion, stream cleanouts (removing woody debris from the channel), and from the reduction in beaver activity. These three factors have been paramount in lowering the water table to the point that lodgepole pine trees could out-compete riparian dependant native sedges and shrubs. Riparian shrubs such as willow help reduce the effects of warming due to solar radiation by providing shade and bank stability. The broad, bushy shape of these shrubs can provide more shade to a small stream channel than the tall, spindly lodgepole can. Riparian dependant sedges and shrubs also provide bank stability, maintaining a relatively deep and narrow low flow stream channel, thus reducing the surface area of water exposed to the warming effects of solar radiation. The Davis Fire will likely benefit the stream's condition. In

addition to riparian planting and log placement, the removal of the lodgepole pine by the fire will aid in allowing riparian-dependent species to become more dominate.

Existing areas denuded of riparian vegetation as a result of dispersed, unmanaged recreation would remain at current levels or improve. Foreseeable actions include closure of spur road 600 which is primary access for vehicles to access the creek bank and camp.

Although stream temperatures are expected to increase in the short term (0-5 years), the recovery of riparian vegetation will eventually lead to lowered stream temperatures within approximately five years. Similar to the no action alternative, riparian vegetation will recover and it is expected that the rate of recovery can be increased through the planting of native shrubs along Odell Creek. Decadent willow, alder, and other riparian species are already resprouting along Odell and Ranger Creeks. These species are typically fast growing, especially in the absence of the now burned overstory of lodgepole pine. These plants should be providing shade to these bodies of water within five years.

A log placement project scheduled for the summer of 2004 would potentially increase stream shade for the lower 1.5 miles of Odell Creek. Approximately 150 logs will be placed in logjam structures. The surface of these logs and the expected log recruitment from burned lodgepole would provide additional shade.

If additional instream large wood placement projects are implemented in Reaches 2 and 3 of Odell Creek stream temperatures should decrease as a result. As with the wood placement project described in Reach 1, the logs should provide additional cover/shade and result in additional ground water storage through increased floodplain connectivity.

Surface water on Odell Lake is heated prior to moving downstream via Odell Creek. Odell Creek originates as lake surface water, which is relatively warm (up to 25°C), then is cooled as it moves downstream by Maklaks and other spring fed tributaries. The stream then resumes warming until its confluence with Davis Lake. By storing additional water on the surface of Odell Lake, an increased amount of water is being heated to surface water temperatures. The delayed release of this warm water reduces the cooling effect of the spring fed tributaries. If flows out of Odell Lake were not artificially altered, flows would more significantly decrease late in the summer and early fall. The cooling effect of the springs would be increased as a greater percentage of the combined flows would originate from a cold spring source rather than lake surface water. Therefore there would be less water in the channel, but it would be cooler. In effect, by releasing stored, heated water in the late summer and fall, that water may be polluting the water quality downstream.

The Seven Buttes Return, Five Buttes Interface, and Crescent Lake WUI projects should have no effect on stream temperatures within the Davis Fire Recovery area. These are thinning projects which will promote large tree growth and reduce large scale fire potential. No activities will occur within the riparian reserve or RHCA as part of these projects. The Charlie Brown project to the north will have no effect on water temperatures in Davis Lake, Moore Creek, Ranger Creek, Crescent Creek or Odell Creek. Wickiup Reservoir lies to the north of the project area. Fuels treatments have occurred within 150 feet of the reservoir as part of the Charlie Brown project. Water temperatures are not expected to measurably increase due to these vegetation management projects.

Sediment

During 1998 Forest Service level II stream surveys, substrate was visually estimated in each main channel habitat unit and two modified Wolman pebble count surveys were performed in each reach of Odell Creek. Both the estimated substrate and pebble counts indicated that gravel and cobble were the most common types of substrate with cobble being more dominant in reaches 2 and 3. Amounts of fines were highest in reach 1 while boulders were more common in reach 3.

Table 3.100 Estimated Percent Substrate within the Wetted Main Channel Odell Creek

Reach	Sand <.08”	Gravel	Cobble	Boulder	Bedrock
1	14.4 %	72.7 %	12.2 %	0.6 %	0.0 %
2	13.1 %	45.7 %	39.8 %	1.2 %	0.2 %
3	4.7 %	40.0 %	50.5 %	4.5 %	0.4 %

Table 3.101 Substrate Percentages from Pebble Counts within the Bankfull Channel of Selected Riffles

Reach	NSO #	Riffle #	Sand < .08”	Gravel	Cobble	Boulder
1	39	16	25 %	72 %	4 %	0 %
1	66	28	34 %	43 %	23 %	0 %
2	107	44	12 %	60 %	28 %	0 %
2	125	51	12 %	39 %	49 %	0 %
3	178	72	11 %	30 %	42 %	17 %
3	210	83	15 %	40 %	38 %	2 %

Substrate in Ranger Creek was visually estimated during stream surveys as gravel and sand dominated (USFS 1990, 1995). An earlier survey measured 5% cobble, 15% gravel, 70% sand and 10% silt (USFS 1979).

Silt and sand-sized matter dominate the substrate of the lake.

USFS level II stream surveys of Crescent Creek have documented that gravel is the dominant substrate type in all reaches except 2 and 11, which were boulder dominated. Lower gradient stream reaches have relatively high percentages of fine sediment (<2mm). Extreme flow modifications resulting from dam operations may be contributing to the unstable bank conditions found in small areas of bank instability in two reaches.

Direct and Indirect Effects

Alternative A

There is potential for post-fire storm flow to contribute ash and erode soil along Odell and Ranger Creeks. However, due to the highly porous soils, flat topography and woody material on the floodplain and new growth of riparian vegetation; this should be limited to the area directly adjacent to the stream channels.

Alternatives B, C, D, and E

No commercial timber harvest would occur within riparian reserves under any of these four action alternatives. Riparian buffers would be maintained as described in the Odell Watershed (USFS 1999). Commercial timber harvest and roads construction in particular (Megahan 1971, Megahan 1980, Beschta 1978) could lead to additional sediment delivery to the streams and lake. All proposed ground based timber harvest is well outside riparian reserve areas and sediment delivery zones.

Increased sediment delivery is not expected as a result of proposed activities (see Soils section, page 3-79). This is due to the following factors: the area is relatively flat; salvage units are located away from delivery mechanisms; advanced harvest systems are utilized where there is minor potential for sediment delivery (see page 3-69 for a description of estimated sediment delivery zone of 480 feet); riparian buffers would have no active management within them; road densities are being reduced by 28 miles; and soils have high infiltration rates.

An estimated 2.7 to 11.4 miles of temporary road construction would occur on the upslopes under Alternatives C-E. McIver (2000) and others have shown that logging roads are most often the source of increased sedimentation in streams and habitat degradation. Temporary road construction could lead to increased sediment delivery to Davis Lake and Odell Creek. However, this is not expected as the roads will be decommissioned following project implementation. Best Management Practices and provisions within the timber sale contract are incorporated into this project. These temporary roads could have the potential to increase sediment routing to Davis Lake and Odell Creek until they are reclaimed by vegetation, within approximately five years. Proposed harvest units lie ½ mile to the East of Odell Creek, which lies in the middle of a lacustrine valley. Sediment delivery from the upslopes is expected to be minimal across this broad, flat and highly porous valley bottom.

Stream density in the project area is low due to the highly porous glacial and Mazama ash that blanket the area (USFS 2003). There are no streams flowing through proposed harvest areas as water quickly penetrates the soil then moves down slope as subsurface flow. Moderate slopes and a very flat valley bottom further contribute to this condition. Therefore, no increase in sediment delivery to any water body, either in the short or long term, as a result of temporary road construction is expected.

One potential haul route (Forest Road 4660) crosses Odell Creek. Hauling over Odell Creek would increase the volume of airborne road dust to the stream during dry periods or mud during wet periods. Increasing the amount of dust or fines to the stream would be detrimental to stream health. The following mitigation measure is designed to eliminate potential sediment delivery into Odell Creek: If haul occurs during May or June, filter cloth fencing would be installed in the ditches on either side of the stream crossing. This measure has been implemented on similar operations nearby and is expected to be effective.

Cumulative Effects

Common to All Alternatives

A log placement project scheduled for implementation during the summer of 2004 along the lower 1.5 miles of Odell Creek should provide additional stability to Odell Creek and reduce sedimentation due to bank erosion. Approximately 150 logs would be placed in logjam structures, which would increase roughness, decrease stream energies, protect banks, reduce sediment transport and increase floodplain connectivity.

Future culvert improvement projects at the intersection of Odell Creek and FS road 4660 and at the intersection of Maklaks Creek and FS road 4668 would result in short term (less than 1 week) increases or pulses of sediment from having equipment working in or adjacent to the stream channel. These pulses of sediment would be short lived and the long-term effect of rehabilitation efforts would be beneficial. At each site the potential for the pipe to become plugged or blown out would decrease. In the event of a blown out culvert, for example at Odell Creek and the 4660 road, there would be a large amount of angular road fill sediment quickly released into Odell Creek, degrading habitat downstream. In addition to reducing the risk of culvert failure, velocities would be decreased at these points as flows would no longer be funneled through a restricted area, thus decreasing stream power and reducing erosion potential.

If future instream rehabilitation projects were implemented in Odell Creek, they too would likely have a short-term negative effect resulting from instream equipment operation. Work would be accomplished during pre-approved periods when bull trout are not likely to be present (ODFW in-stream period). The long term effects would be beneficial as stated above. Stream velocities would be reduced, floodplain connectivity would be improved, sediment transport reduced and suspended fine sediments and seeds would be deposited on the floodplain during peak events rather than remaining in channel, contributing to vegetative recovery and stability.

The Seven Buttes Return, Five Buttes Interface, Crescent WUI and Charlie Brown vegetative management projects when combined with the Davis Fire and Davis Fire Recovery have cumulatively decreased the amount of vegetative cover on the ground and soil disturbance. With decreased vegetative cover, water storage is typically decreased, as more precipitation is able to fall directly to the forest floor and not be retained in the canopy and then evaporated back into the atmosphere. This condition typically leads to increased volumes of sediment mobility. However, given the topography and geology of the area, this sediment is not mobilized and delivered to the stream or lake bodies. Water is quickly absorbed on the slopes and transported downslope

subsurface. This is evidenced by the lack of definable stream channels on the hill slopes. Stream channels and surface flow are only found in the lacustrine valley bottom of Davis Lake. Moore Creek and Odell Creek originate as lake outflow from Bobbie and Odell Lakes respectively. This is not to suggest that the area could support limitless timber harvest and not experience stream degradation as a result. These are thinning projects and much different than a clear cut timber harvest. Soil stability and retention are much higher within a thinning unit than in a clear cut.

Alternative A

There is potential for post-fire storm flow to contribute ash and erode soil along Odell and Ranger Creeks. However, due to the highly porous soils, flat topography and woody material on the floodplain and new growth of riparian vegetation, this should be limited to areas directly adjacent to the stream channels. It is expected that erosion would be relatively minor as bank stability is estimated to be at 96% on Odell Creek within the project area. Areas of bank instability are limited to a few isolated sites where the vegetation has been killed by fire and bare soils have been exposed. Sediment input should decrease within five years as riparian vegetation becomes well established and stabilizes these soils. Additional sediment input may result as dead lodgepole pine trees tip over, exposing their root mass and the soil around them.

Alternatives B, C, D, and E

There is potential for post-fire storm flow to contribute ash and erode soil along Odell and Ranger Creeks. However, due to the highly porous soils, flat topography and woody material on the floodplain and new growth of riparian vegetation, this should be limited to areas directly adjacent to the stream channels. It is expected that erosion would be relatively minor as bank stability of Odell Creek is estimated to be at 96% within the project area. Areas of bank instability are limited to a few isolated areas where the vegetation has been killed and left bare soils. Sediment input should decrease within five years as riparian vegetation becomes well established and stabilizes the soils. Recovery of riparian vegetation may occur more quickly through the implementation of any of Alternatives B-E, than with Alternative A, as the riparian area would be planted with native riparian shrubs. Shrub plantings would supplement the natural recovery already under way. Additional sediment input may result as dead lodgepole pine trees tip over, exposing their root mass and the soil around it.

Commercial timber harvest and roads construction in particular have the potential to lead to additional sediment delivery to the streams (Megahan 1971, Megahan 1980, Beschta 1978). This is not expected as proposed timber harvest is located adjacent and to the east of Davis Lake where there are no streams or delivery mechanisms to transport the sediment to Davis Lake or Odell Creek. Although it is estimated that between 2.7 and 11.4 miles of temporary road construction would occur, these roads would be outside of riparian reserve areas and would be decommissioned following project implementation. The exact location of these temporary roads has not yet been identified, however it is known that they would be outside of the riparian reserve and/or RHCA as no commercial activities will occur within those areas. Temporary roads will be constructed along ridge lines or on flat ground.

Riparian grasses and forbs within the burn area, as well as bushes and shrubs have recovered very well during the spring of 2004. In walking Odell Creek several times throughout the spring and early summer, The District Fisheries Biologist observed no evidence of increased surface flow reaching Odell Creek or rills or gullies forming across the flat valley bottom. Areas of rilling were observed on the steeper slopes of Davis and Hamner Buttes during a spring rain on snow storm event (Powers, personal communication). These small areas of flowing water were coming off of snow and running a short distance down the road before disappearing.

Small Fuels reductions within approximately 60 acres of riparian area and riparian reserves along lower Moore Creek and the western shoreline of Davis Lake should create an area for a firebreak. Firebreaks are areas where future fires could be intercepted to reduce the potential for an additional large scale fire in this vicinity. Reducing the reburn potential for this area should allow for the recovery of mature vegetation more quickly.

Although there will be an expected short-term impact from culvert replacement and instream log placement, sedimentation as a result of the cumulative management activities is not expected to raise turbidity values to levels above baseline. Studies indicate that the ability of salmonids to capture food may be impaired at turbidity values in the range of 25 to 70 Nephelometric Turbidity Units (NTU). Growth may be reduced and gill tissues damaged after 5 to 10 days exposure to turbidity of 25 NTU, and some species may be displaced at 50 NTU (MacDonald et al., 1991). Turbidity is a result of suspended clay or silt particles in the water column and occurs during storm runoff events. Oregon administrative rules state, "No more than 10 percent cumulative increases in natural streams turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity" (OAR Chapter 340, Division 41-DEQ).

Chemical Contaminants/Nutrients

The pH of Odell Lake and Odell Creek exceeded the State standards of 8.5 on five separate occasions peaking at 9.8 in the epilimnion and 10.0 in Odell Creek during August 2001. Secchi disc measurements along with chlorophyll α density measurements indicated an algal bloom of green algae and possibly blue-green algae occurred from late July through September 2001. The pH of the epilimnion (μ= 8.9) was greater than the hypolimnion (μ = 7.5) throughout the summer months indicating the effect of the phytoplankton on the carbon cycle and pH (Houslet 2001). Sampling conducted in 2003 and 2004 has documented high levels of the blue-green algae (cyanobacteria) Anabaena flos-aqua in Odell Lake during the month of July. Algae level monitoring is ongoing as is toxin analysis for anatoxin a and microsistin.

Analysis of phosphorus and nitrogen derived nutrients found no elevated levels of nutrients being input into the system from tributary sources. Nitrogen was found to be limited in Odell Lake during the early summer (5.2:1) then became phosphorus limited during late summer and fall (49.6:1). Water quality sampling in 2002 found dissolved oxygen minima occurring in the epilimnion of Odell Lake. Measurement of 3.0 mg/ L dissolved oxygen was recorded during that time (Houslet 2002).

Retardant drops occurred during suppression of the Davis Fire. See Soils section for a discussion of retardant, beginning on page 3-85. Field reconnaissance for consultation of fire suppression activities with U.S. Fish and Wildlife Service did not reveal evidence of residues on adjacent riparian vegetation or fish mortality along the perennial stream reach.

Further movements through the soil profile of individual nutrients contained in the residues are possible as follows:

1. Residual amounts of sulfuric and phosphoric acids from the retardant not volatilized during the fire are likely to have combined with cations produced by partial combustion of ground and vegetative fuels and then percolated into the soil matrix. Products derived from phosphates that reach the soil matrix are readily adsorbed and fixed to mineral and organic exchange sites in these soils. Products derived from sulfates are more likely to be leached into the groundwater.
2. Residual ammonium nitrogen not taken up by plant roots can be nitrified into nitrate products susceptible to leaching through the soil profile and into groundwater. Inputs of nitrates into the groundwater system would decrease over subsequent growing seasons as vegetative uptake of available nitrogen on site increased toward pre-fire levels (CSIRO 2000).

The proximity of retardant to stream courses would determine whether residues dissolved in concentrated precipitation or present on mineral soil particles would be transported to channel courses or infiltrated into the soil profile. The two drops that occurred across stream drainages are obviously close enough to contribute surface or subsurface flows to these drainages should a rainfall event occur. Potential inputs from retardant residues include ammonium nitrogen or yellow prussiate of soda from the Fire-Trol product, both of which can be toxic to fish. Ammonium concentrations in stream flows have been measured to be 0.4 to 50 mg/L from direct applications of retardant to surface waters and 0.01 to 0.8 mg/L from surface runoff emanating from adjacent upland soils applied with retardant (Boivin and Bailor 1996).

Although products present in performance additives are likely to be less mobile within the soil profile than ammonium nitrogen, excessive precipitation could dissolve and transport the yellow prussiate of soda (YPS) component within Fire-Trol products into surface waters. YPS contains sodium ferrocyanide that can release

free cyanide under exposure to UV radiation while in solution. The risk of creating levels toxic to fish through this mechanism has been shown to decrease significantly after applied residues are exposed to sunlight for 45 days or more before being dissolved into solution. Residues are likely no longer present as a source of these components to the system following this time period (Little and Calfee 2002).

Rains recorded during the August 2003 event was measured to be 0.32 inches, which was very likely insufficient to create surface flows within the intermittent drainage, especially considering the infiltration rates of the surface soils, low soil moistures present during the summer months and nearly level slopes of the immediately adjacent upland slopes. Runoff into the perennial reach of Odell Creek is also likely to have been very low from this rainfall event for these same reasons, in addition to the relatively controlled flow of this reach from spring-fed and lake outlet sources that limits flows above bankfull outside of spring peak flows.

Sulfates and nitrates that could reach surface flows of Odell Creek or Davis Lake via tributary groundwater sources after leaching through the soil profile should be in limited concentrations due to dilution factors provided by the volumes in each waterbody. Neither surface waterbody is a direct drinking water source and there are no water quality standards for nitrate in wildland surface waterbodies. There are two wells that provide drinking water at East and West Davis campgrounds located within a mile of three retardant drop points. These wells are drilled at a depth of 65 and 80 ft, respectively. National drinking water standards for nitrates in public drinking water supplies are 45 mg/l nitrate or 10-mg/l nitrate nitrogen (Stednick 1991). Pre-fire monitoring data of these supplies shows nitrate levels of <0.1-mg/l nitrate (North Creek Analytical, 2003). The water sources have been shut off since the fire event and have not been measured for water quality. Regular protocol for these sources has been annual tests for nitrate and coliform levels.

Dicamba is an herbicide that acts by mimicking the plant hormone indole-3-acetic acid. This herbicide is used at site-specific locations alongside Forest Service road 46 (Cascade Lakes Highway) to control noxious weeds. This herbicide is used for spot applications over a ½ acre total area at a concentration of 17 oz within that ½ acre area. The use of dicamba has been approved under a 1998 noxious weeds EA. Toxicity studies indicate that dicamba is relatively non-toxic, with 24 to 96 hour LC_{50} (Lethal Concentration, 50% kill) values in the range of 28-516 mg/L. Salmonids appear to be more sensitive to dicamba than other freshwater fish. Some aquatic invertebrates appear to be more sensitive than fish and amphibians. Aquatic plants are more sensitive than aquatic animals. (www.sera-inc.com).

Direct and Indirect Effects

Alternative A

There is potential for post-fire storm flow to contribute ash and erode soil along Odell and Ranger Creeks, which could increase pH and ammonia (Davis Rapid Assessment 2003). However, due to the highly porous soils, flat topography and woody material on the floodplain and new growth of riparian vegetation, this should be limited to area directly adjacent to the stream channels.

Alternatives B, C, D, and E

There is potential for post-fire storm flow to contribute ash and erode soil along Odell and Ranger Creeks, which could increase pH and ammonia (Davis Rapid Assessment 2003). However, due to the highly porous soils, flat topography and woody material on the floodplain and new growth of riparian vegetation, this should be limited to area directly adjacent to the stream channels. Studies have shown that commercial timber harvest, and roads construction in particular, could lead to additional sediment delivery to the streams, which could increase pH and ammonia (Megahan 1971, Megahan 1980, Beschta 1978).

This is not expected under the action alternatives as proposed timber harvest is concentrated to the east of Davis Lake, where there are no streams or delivery mechanisms to transport the sediment to Davis Lake, Ranger Creek or Odell Creek.

By using advanced harvest systems where there is potential for sediment movement, application of best management practices, reducing road densities, and maintaining riparian reserves, sediment delivery and associated increases in nutrients is not a concern.

Cumulative Effects

All Alternatives

There is potential for post-fire storm flow to contribute ash and erode soil along Odell and Ranger Creeks, which could increase pH and ammonia (Davis Rapid Assessment 2003). However, due to the highly porous soils, flat topography and woody material on the floodplain and new growth of riparian vegetation, this should be limited to area directly adjacent to the stream channels. It is expected that erosion would be relatively minor as bank stability is estimated to be at 96% within the project area. Areas of bank instability are limited to a few isolated locations where the vegetation has been killed and left bare soils. The input of nutrients at these sites will be short lived (<5 years), as riparian vegetation would stabilize the soils.

Commercial timber harvest and roads construction in particular (Megahan 1971, Megahan 1980, Beschta 1978) could lead to additional sediment delivery to the streams. This is not expected as proposed timber harvest is located to the east of Davis Lake, where there are no streams or delivery mechanisms to transport the sediment to Davis Lake or Odell Creek. Although it is estimated that between 2.7 and 11.4 miles of temporary road construction would occur, these roads would be decommissioned following project implementation. Additionally 31 miles of road would be closed and another 6 miles obliterated. There would be an overall reduction in road densities for all eight subwatersheds.

A log placement project scheduled for implementation during the summer of 2004 along the lower 1.5 miles of Odell Creek should provide additional stability to Odell Creek and reduce sedimentation. Approximately 150 logs would be placed in logjam structures, which would increase roughness, decrease stream energies, protect banks, reduce sediment transport and increase floodplain connectivity.

Likewise if additional stream rehabilitation projects are implemented in the future, water quality should benefit as described for the wood placement project in Reach 1.

In all of the potential and foreseeable stream rehabilitation projects and culvert improvements, there is the potential for chemical contamination due to the equipment. When using heavy equipment instream there is always the possibility of hydraulic, oil, grease or radiator fluid leak. Spill kits would always be on site for use in the event of such a spill. Contaminated soil would be removed from the site for treatment at an appropriate facility.

Fire retardant dropped in the project area is assumed to have dissipated at this point as described in the Soils section, 3-85.

Dicamba is not expected to reach any water bodies as the herbicide is applied along FS 46 for spot treatments. There are no stream crossings along the FS 46 and therefore no delivery mechanisms to carry the herbicide directly to Odell Creek or Davis Lake. The herbicide could leach down through the soil and enter the ground water table and then be transported to the stream or lake, however by that time concentrations would not likely be great enough to pose a risk to aquatic organisms.

HABITAT ACCESS

Physical Barriers

A small rock weir (approximately 10 inches tall) is constructed across the outlet of Odell Lake/head of Odell Creek each year during low flow periods. The owners of the East Odell Lake Lodge and cabin owners construct the small weir in an attempt to increase the static water level in Odell Lake to maintain use of boat docks. This weir currently violates a public trust water right in Odell Creek. Negotiations are underway in an attempt to find an alternative to this weir. Before bull trout were listed, a ten year old agreement between the state of Oregon, the East Odell Lake Lodge owner and the USFS allowing the weir to be constructed required that a four to six foot wide fish passage opening be maintained. This practice has not always been easy to maintain. The rock weir is typically removed at the end of October either by the East Odell Lake Lodge operators or by high flows.

A 7.6-foot waterfall on Trapper Creek at river mile 0.66 may pose an upstream barrier for bull trout. Redd surveys conducted over the past six years have failed to document a redd above these falls.

Downstream fish migration, out of the Odell system is blocked by a 5,500-year-old lava flow. The lava flow crossed Odell Creek to form Davis Lake. Prior to this lava flow, Odell Creek flowed into the Deschutes River at what is now Wickiup Reservoir.

Access to Crystal Creek, a stream which was significant for bull trout spawning may be limited due to a thermal barrier in Pebble Bay of Odell Lake. Crystal Creek flows into Pebble Bay, which is shallow (5-10 feet deep). Surface water temperatures in the lake during mid and late summer months are typically in the mid 60 degree Fahrenheit.

The only barrier on Crescent Creek is the dam at the outlet of Crescent Lake. This dam does not allow passage between the two waterbodies.

Direct, Indirect, and Cumulative Effects

All Alternatives

Implementation of any of the four alternatives would not directly or indirectly, or cumulatively create or remove any aquatic barriers. Maintenance of buffers would allow natural recruitment of standing dead trees into the channel post-fire. Survey and design efforts are underway to replace two culvert crossings with a bridge in the case of Odell Creek at the 4660 road and a bottomless arch at Maklaks Creek and the 4668 road. The culverts are at least partial barriers to fish at one life stage. Replacement of culverts will allow uninhibited fish passage.

HABITAT ELEMENTS

Substrate Embeddedness

Information is unavailable in regards to the rearing area substrate embeddedness of Odell Creek. Qualitative observations of embeddedness by the fisheries biologist rated reach 1 (the reach within the fire perimeter) as functioning properly. However, reaches 2 and 3 appear to be functioning at risk. The higher gradient stream channel in the upper reaches coupled with few large wood jams, has lead to a series of very long riffles with relatively large substrate size. This scenario typically results in smaller substrate material being flushed out during peak events, leaving only the larger, bed-armoring substrate behind.

Information is not available for Moore and Ranger Creeks.

Direct and Indirect Effects

All Alternatives

Embeddedness is the result of smaller sized materials settling into interstitial pockets between pieces of gravel or cobble. Due to the low potential for sedimentation, the possible embeddedness as a result of delivery of silt is considered very low. Refer to the Soils Section for more discussion on sediment potential.

Cumulative Effects

All Alternatives

As the riparian vegetation recovers over the next five years erosion rates would be reduced. As riparian grasses and shrubs become re-established, suspended sediments in the water column will be filtered out and deposited on the floodplain during peak flow events.

A log placement project scheduled for implementation during the summer of 2004 along the lower 1.5 miles of Odell Creek should provide additional stability to Odell Creek and reduce sedimentation. Approximately 150 logs would be placed in logjam structures, which would increase roughness, decrease stream energies, protect banks, reduce sediment transport and increase floodplain connectivity.

Future instream rehabilitation projects as well as culvert improvements will likely cause short lived (less than 3 weeks) pulses of increased sediment during project implementation. The increased amount of sediment could result in increased embeddedness. This is a short term condition because the minor amount of silt would be flushed out with the next water event. Also, activities would occur during the ODFW in-stream work period when bull trout are absent. The long-term effect of these projects would be beneficial to stream quality as sediment mobilization and transport would be reduced. In addition, over widened sections of stream, which now function as depositional zones could be improved by narrowing the channel and increasing roughness along the margins. This would maintain stream energies in the thalweg and potentially reduce embeddedness.

The Seven Buttes Return, Five Buttes Interface, Crescent WUI and Charlie Brown vegetative management projects when combined with the Davis Fire and Davis Fire Recovery have cumulatively decreased the amount of vegetative cover on the ground and soil disturbance. With decreased vegetative cover, water storage is typically decreased, as more precipitation is able to fall directly to the forest floor and not be retained in the canopy and then evaporated back into the atmosphere. This condition typically leads to increased volumes of sediment mobility. However, given the topography and geology of the area, this sediment is not mobilized and delivered to the stream or lake bodies. Water is quickly absorbed on the slopes and transported downslope subsurface. This is evidenced by the lack of definable stream channels on the hill slopes. Stream channels and surface flow are only found in the lacustrine valley bottom of Davis Lake. Moore Creek and Odell Creek originate as lake outflow from Bobbie and Odell Lakes respectively. As there are not increased volumes of sediment being delivered to the stream channels, embeddedness should not be altered as a result of project activities.

Large Woody Debris

Large wood is not overly abundant in Odell Creek; only six pools within the 7.5 miles of stream channel had more than three pieces of large woody debris associated with them (table 3.102). The most recent stream survey conducted on Odell Creek (1998) documented several pieces of wood per mile in each of the three reaches; however, roughly 80% of this woody material fits under the small size classification. The three size classes used for east side streams are small (20 feet X 6 inches at the small end), medium (35 feet X 12 inches) and large (35 feet by 20 inches). Wood within the burn perimeter is not often accumulated in jams or complexes, instead it is typically found as individual pieces. The high volume of small wood does relatively little to develop and maintain high quality pools within this system. Large wood is necessary to maintain floodplain connectivity and an elevated water table. Large wood is also fundamental in these stream types for maintaining stream channel pattern, profile, and dimension. Large wood maintains pools, provides cover year round and a place of refuge during high or low flows and increases the abundance of organic material for macroinvertabrates. Improving habitat and biological function in aquatic systems.

Table 3.102 Pool Attributes in Reaches 1-3 of Odell Creek

Reach Number	Number of Pools	Pools/Mile	Pools > 3 ft Deep/Mile	Pools With 1-3 pieces of LWM	Pools With > 3 pieces of LWM
1	32	16.9	15.9	14	5
2	25	12.3	9.4	10	1
3	25	7.3	1.2	11	0

Table 3.103 Wood Volume in Odell Creek

Reach	Small	Medium	Large	Total	Total per Mile
1	333	75	3	411	242
2	336	39	48	423	192
3	245	46	51	342	95

The last habitat assessment of Ranger Creek was completed in 1995, which found wood densities of 27 pieces per mile >12" and 904 per mile <12" (USFS 1995).

Large wood is nearly non-existent in Davis Lake. A few small wood clusters had been placed at the outlet of Odell Creek, however, many of these have since been redeposited on the floodplain.

Using the Region 6 Level 2 Stream Inventory protocol, woody debris within the bankfull channel of Crescent Creek was classified into three size classes. The three size classes used for east side streams are small (20 feet X 6 inches at the small end), medium (35 feet X 12 inches) and large (35 feet by 20 inches). Results of the 2002 survey are listed below.

Table 3.104 Woody Debris Abundance within Bankfull Channel of Crescent Creek

Reach	Pieces of Medium and Large Wood	Pieces of Small Wood	Pieces of Medium and Large/Mile	Pieces of Small/Mile
1	55	185	32.4	108.9
2	16	49	17.9	54.7
3	2	13	5.4	35
4	11	90	14.3	117.1
5	4	23	8	45.9
6	8	71	20.1	181.5
8	35	371	28.3	300
10	35	194	76.5	423.8
11	16	177	16.3	180.7

Wood recruitment in this landscape occurs nearly exclusively from riparian contributions. Landslide and/or debris torrents are not common events and therefore do not contribute sediment or large woody debris to the stream network from the upslopes.

Direct, Indirect, and Cumulative Effects

All Alternatives

No instream work or commercial timber harvest in riparian reserves would occur as part of this project. Wood would neither be added nor removed from stream channels. Dead and dying lodgepole pine trees are and will continue to fall over for the next 20 years, contributing to the volume of instream and floodplain wood.

Dead and dying lodgepole pine trees are and will continue to fall over for the next 20 years or so, contributing to the volume of instream and floodplain wood. Wood recruitment will occur from riparian and not upslope sources as would occur in landslide and debris torrent landscapes.

A log placement project scheduled for implementation during the summer of 2004 along the lower 1.5 miles of Odell Creek should provide additional stability to Odell Creek and reduce sedimentation. Approximately 150 logs would be placed in logjam structures, which would increase roughness, decrease stream energies, protect banks, reduce sediment transport and increase floodplain connectivity.

Likewise, if stream rehabilitation projects are implemented on the upper reaches of Odell Creek, the amount of LWD and logjams would be increased.

Replacement of the culverts at the 4660 road crossing of Odell Creek would likely allow for the passage of logs and woody material from the upper reaches down into reach 1.

Large wood recruitment to area water bodies is not anticipated to be affected regardless of which alternative is selected. Riparian Reserves and RHCAs are being maintained at 300 feet for all perennial streams and water bodies and 50 feet for ephemeral drainages.

The Seven Buttes Return, Five Buttes Interface, Crescent WUI and Charlie Brown vegetative management projects when combined with the Davis Fire and Davis Fire Recovery will have no effect on wood recruitment to area water bodies. These projects have no commercial harvest within riparian reserves and do not prevent or reduce attainment of large wood.

Pool Frequency and Quality / Large Pools

Odell Creek:
Reach 1: River Mile 0.0 to 1.7, first campsite on left upon entering Davis Lake Campground to Road 4660 crossing.
Reach 2: River Mile 1.7 to 3.9, road 4660 crossing to the confluence with Maklaks Creek.
Reach 3: River Mile 3.9 to 7.5, confluence with Maklaks Creek to the outlet of Odell Lake.

Riffle habitat dominates all three reaches with more pool and side channel area in reaches 1 and 2. Pool formation is mainly a function of lower gradient in these two reaches. Straight scour pools are most common in reaches 1 and 3 while reach 2 is evenly split between straight and lateral scour pools. See table 3.125

Pools in Ranger Creek were defined as backwaters of beaver dams, logjams or entrenchments in bends. During the 1990 stream survey 8 pools were identified within the 1.5-mile stream, 5.3 pools per mile. Glides were the dominant habitat type, making up 67% of the survey area (USFS 1990).

Table 3.105 Pool Attributes in Reaches 1-2 of Ranger Creek

Reach Number	Number of Pools	Pools/Mile
1	5	6.17
2	3	4.3

Water depths in Davis Lake fluctuate, but are generally shallow. There are few isolated spots along the lava flow, to the north end of the lake, where the depths are a couple feet deeper than the rest of the lake.

Water surface elevation is estimated to have been at 4395.4 feet prior to 1728 and has been recorded as high as 4392.1 in 1958 and as low as 4376.1 in 1941 (Phillips 1968).

Crescent Creek pools in excess of three feet residual depth and pool habitat area are highest in reach 1. Pools in reaches 2 and 4 are generally very long and slow moving, accounting for a high percentage of pool habitat but few pools per mile.

Table 3.106 Pool Attributes Crescent Creek

Reach	# of Pools	% Pools	Avg Pool Residual Depth (ft)	Pools > 3ft Deep	Pools/Mile	Pool Area (feet^2)
1	17	29.9	2.4	14	10	161,104
2	11	21.9	2.2	3	12.3	47,293
3	9	59.9	1.9	4	24.2	41,347
4	16	41.2	1.7	3	20.8	69,332
5	12	56.2	2.3	4	24	57,741
6	12	51.5	2.1	3	30.7	35,851
8	29	35.3	1.6	3	23.5	76,082
10	14	31.3	1.1	0	30.6	18,715
11	8	6.7	1.8	0	8.2	13,836

(Dachtler 2001)

Direct and Indirect Effects

All Alternatives

The quantity and quality of pools should remain unchanged for both streams and Davis Lake. It is possible that if an increased amount of sediment were delivered to Davis Lake, the outlet could become clogged resulting in an increased water elevation. This however is not expected, as no measurable increase in sediment is anticipated. Additionally, the lava flow is so porous that any plugging resulting from sediment would simply direct the water out through other openings. In 1967 the USFS and ODFW unsuccessfully tried to plug the seepage out of Davis Lake with 7,500 cubic yards of fill material (Stahlberg 1994).

Cumulative Effects

All Alternatives

The log placement project described before may increase pool quality and quantity. If stream rehabilitation projects are implemented in Reaches 2 and 3 of Odell Creek, a major component of those projects would be to create additional high quality pools through the strategic placement of logjam structures.

Off Channel Habitat

Side channel habitat within reaches 1 and 2 of Odell Creek make up 21 and 29% of the total available habitat respectively. Off channel habitat within reach 3 is virtually nonexistent. Likewise, many of the tributaries to both Odell Lake and Odell Creek have few off channel areas.

Side channel habitat in Crescent Creek is abundant. Several old stream meander bends remain as connected oxbows. A total of 30 side channels were recorded in 2001 (Dachtler) on Forest Service lands between Forest Service Road 61 and the Crescent Lake Dam, a distance of a little more than 10 miles.

Table 3.107 Side Channel Attributes of Crescent Creek on Forest Service Administered Lands

Reach	# of Side Channels	% Side Channels	Side Channel Width	Avg Side Channel Depth (ft)	Side Channels/ Mile	Side Channel Area (feet^2)
1	6	1.9	18.8	1.6	3.5	10,017
2	0	0				
3	3	4.7	14	1	8.1	3,240
4	3	2.1	17.7	1.3	3.9	3,530
5	1	3.8	30	2	2	3,900
6	3	12.4	16.3	1.3	7.7	8,640
8	8	9.9	14.8	1.4	6.5	21,373
10	3	13.2	11.7	.8	6.5	7,820
11	3	0.3	3	.4	3.1	570

(Dachtler 2001)

Depending on the discharge level, fewer or more side channels may be active than are accounted for in this table. The data displayed above is from surveys completed in August and September of 1999 and 2001.

Direct, Indirect, and Cumulative Effects

All Alternatives

Natural recruitment of dead and dying lodgepole pine trees may activate sidechannels as the result of water displacement. This will likely occur regardless of which alternative is selected. No commercial harvest will occur within riparian reserves, so wood recruitment should be uninhibited by implementation of any of the action alternatives.

Natural recruitment of dead and dying lodgepole pine trees may lead to the activation of sidechannels through water displacement. A log placement project scheduled for implementation during the summer of 2004 along the lower 1.5 miles of Odell Creek should provide additional stability to Odell Creek and reduce sedimentation. Approximately 150 logs would be placed in logjam structures, which would increase roughness, decrease stream energies, protect banks, reduce sediment transport and increase floodplain connectivity. Off channel habitat will likely be more accessible as the result of the improved floodplain connectivity.

If stream rehabilitation projects are implemented in Reaches 2 and 3 of Odell Creek, there may be an increase in the availability of off channel habitat in those reaches as well. Reaches 2 and 3 do not lie in as broad of a valley as does Reach 1 and the valley slope tends to be greater, therefore, there is less sidechannel potential

than in Reach 1. However, as a result of floodplain connectivity, there would be some increase in sidechannel accessibility expected, especially during bankfull or greater discharge events.

Refugia

The consistently low number of spawning adults in the Odell system during the past several decades indicates that there is little in the means of refugia for the population. The current available habitat does not appear to be capable of supporting strong and significant populations. Connectivity within the watershed for all life stages has been compromised during the past century. A rock weir at the outlet of Odell Lake likely inhibits the movement of juveniles and adults in and out of Odell Creek. A concrete dam constructed in the 1920's blocked fish passage on Crystal Creek for 80 years. Sedimentation of Pebble Bay (mouth of Crystal Creek) may be creating a thermal barrier for returning adults to Crystal Creek as the bay has become shallow (5-10 feet deep), forcing fish to travel through the warm surface water of Odell Lake. The only known active spawning habitat within the Odell watershed is found in Trapper Creek. Trapper Creek had been significantly altered through the development of a campground along one of its banks, road and railroad construction across the channel, berming and installation of rock/wire gabions along the banks and bed to reduce flooding. A stream rehabilitation project implemented during the summers of 2002 and 2003 which removed the gabions (780 feet), created off channel habitat (200 feet), increased habitat diversity, created additional pools and greatly increased the amount of instream large woody debris (medium and large from 14 to 111 pieces per mile). The concrete dam in Crystal Creek was notched during the summer of 2003 to allow fish passage over the structure. Negotiations are under way to identify and implement a solution to the rock weir at the outlet of Odell Lake.

Refugia for redband trout in the Crescent Creek system could be found in Cold Creek and to a lesser degree in Big Marsh Creek. Cold Creek is a spring fed, 3rd order stream that enters Crescent Creek at about river mile 24.5. Redband trout and non-native brook trout were found in this stream during a 1999 Forest Service stream survey (Dachtler 1999).

Direct and Indirect Effects

All Alternatives

None of the alternatives would either directly, indirectly, or cumulatively affect refugia. The project is located at the lower end of what is basically a closed watershed. Access to the Deschutes River has been lost for approximately 5,500 years as the result of a lava flow.

Cumulative Effects

All Alternatives

Currently the USFS, USFW, ODFW, Oregon Water master, East Odell Lake Lodge operator and Odell Lake cabin owners are seeking an alternative to the rock weir which is constructed each summer at the outlet of Odell Lake. Uninhibited access between Odell and Davis Lakes would be restored in the absence of this weir.

A culvert improvement project on Maklaks Creek would remove a barrier for fish passage at all life stages and all flows. The existing culvert is undersized and was flagged as "red" during fish passage surveys, indicating that it is a fish passage barrier.

Replacing the five culverts on lower Odell Creek may also improve fish passage. Five culverts lay side by side to pass Odell Creek through the 4660-road prism. These culverts were not flagged as "red" under the fish passage survey, however, they do appear to be a barrier at some flows for some life stages.

CHANNEL CONDITIONS AND DYNAMICS

Odell Creek:

Reach 1: River Mile 0.0 to 1.7, first campsite on left upon entering Davis Lake Campground to Road 4660 crossing.
Reach 2: River Mile 1.7 to 3.9, road 4660 crossing to the confluence with Maklaks Creek.
Reach 3: River Mile 3.9 to 7.5, confluence with Maklaks Creek to the outlet of Odell Lake.

Riffle habitat dominates all three reaches with more pool and side channel area in reaches 1 and 2. Within the main channel, riffles comprised 61, 67 and 83% of the habitat in reaches 1, 2 and 3 respectively (see table 3.99, pool attributes in reaches 1-3). Straight scour pools are most common in reaches 1 and 3 while reach 2 is evenly split between straight and lateral scour pools (Odell Watershed Analysis 1999).

Reach 1, which lies within the Davis burn area, is the only reach within Odell Creek which has adequate amounts of large wood, cool stream temperatures, quality pool habitat and high quality spawning areas. Reach 2 and 3 are higher gradient with less woody debris, sinuosity and fewer quality pools. Stream temperatures are also limiting in Reach 3.

Ranger Creek:

Reach 1: River Mile 0.0 to 0.81
Reach 2: River Mile 0.81 to 1.48

Reach 1 of Ranger Creek is dominated by glide habitat, constituting 67% of available habitat. There are six riffles and five pools. Riffles average 4 meters in width and 12 cm in depth (low flow). Glides averaged 5.2 meters wide and 28.6 cm deep while the five pools average 4.9 meters wide and 49.4 cm deep.

Reach 2 of Ranger Creek is again dominated by glides, with no riffle habitat and only three pools. The pools within Reach 2 average 3.3 meters wide and 51.3 cm deep while the glides average 4 meters wide and 30.4 cm deep (USFS 1990).

Table 3.108. Overall reach characteristics for Crescent Creek between FS Road 61 and Crescent Lake.

Reach	Mapped Gradient	Calculated Sinuosity	Distance Surveyed (miles)	Mapped Valle Width (feet)	Avg Inner Riparian Zon Width (feet)	Valley Side Slope
1	1.1	1.18	1.7	700	50	>30%
2	1.8	1	0.9	130	20	30-60%
3	0.8	1	0.4	370	35	>30%
4	0.6	1.28	0.8	370	35	>30%
5	0.4	1.32	0.5	790	70	>30%
6	0.1	1.3	0.4	1580	70	>30%
8	0.5	2.03	1.2	790	60	>30%
10	0.6	1.2	0.5	160	60	>30%
11	1.7	1.09	1	160	60	>30%

(Dachtler 2001)

Average Wetted Width/Maximum Depth (pools)

Specific data pertaining to the average wetted width over the maximum pool depths is not available for Odell, Ranger or Moore Creeks. Bankfull width to depth ratios for riffles are available for Odell Creek. Bankfull ratios

in riffles range from 25:1 in reaches 1 and 2 to 35:1 in reach 3 (Odell Watershed Analysis 1999). Width to depth ratios are analyzed in context of bankfull discharge, as this is the flow level which shapes and maintains natural stream channels. Bankfull width to depth ratios in Ranger Creek average 6.61 in Reach 1 and 3.97 in Reach 2. High bankfull width to depth ratios like those observed in Odell Creek are typical of C type stream channels. The low width to depth ratio of lower Ranger Creek is more characteristic of an E channel type.

As with Odell Creek, width to depth ratios calculated for Crescent Creek are at bankfull. These values are somewhat inaccurate in that bankfull flows no longer occur as they had prior to the construction of the dam at Crescent Lake. For example, when spring flows are moving out of Whitefish Creek (main tributary to Crescent Lake) at about 60 cfs only 3 or 6 cfs is being passed into Crescent Creek by dam operations. Therefore spring peak flows in Crescent Creek below the confluence with Big Marsh Creek are basically whatever Big Marsh provides, with very little contribution from the upper Crescent Watershed. The two channels do not combine their peak flows and a true bankfull flow is not achieved below the confluence.

Table 3.109 Crescent Creek Channel Attributes

Reach	Entrenchment Ratio	Width to Depth Ratio	Flood prone Width (feet)	Bankfull Width (feet)	Bankfull Depth (feet)	Rosgen Channel Type
1	2.3	36.8	164.8	69.5	2.1	C4
2	1.4	22.5	73.6	55.9	2.8	B4
3	6.3	33.5	278	43.5	1.3	C4
4	1.6	36.8	87	53.7	1.5	B4
5	5.5	31.3	265	48.5	1.6	C4
6	6.4	29.8	273	43	1.4	C4
8	4.9	23.6	171	34.3	1.5	C4
10	2.1	22.1	70	32.5	1.5	C4
11	2	16.5	57	27.5	1.8	B3

(Dachtler 2001)

Bankfull width to depth ratios are simply the measured bankfull width over the average bankfull depth. Floodprone width is obtained by doubling the maximum bankfull depth and measuring the valley width that would be inundated at a flow of that magnitude. The entrenchment ratio is then the floodprone width over the bankfull width. The higher the entrenchment ratio is, the greater floodplain connectivity.

Direct, Indirect, and Cumulative Effects

All Alternatives

No instream work would occur as part of this project under any of the alternatives. Width to depth ratios should remain unchanged.

Natural wood recruitment from dead and dying trees along with a wood placement project scheduled for implementation in the summer of 2004 may lead to an overall reduction in width to depth ratios in Odell Creek. Large wood, especially when accumulated into jams is good at trapping suspended sediments and reducing bank sheer stresses. Over time this can lead to a narrowing of the channel as the banks are built up again from trapped sediment and vegetation growth. The opposite can happen as well. Especially upstream of channel spanning structures in the absence of adequate floodplain roughness, pools can become wider in an attempt to find a way around the impediment.

Stream rehabilitation projects which may occur in the near future (<10 years) along the length of Odell Creek would likely result in the reduction of width to depth ratios. Large wood would be used to construct jams and structures designed to narrow the low flow channel while allowing flows in excess of bankfull to be released onto the floodplain.

Streambank Condition

1998 Odell Creek stream survey data indicates bank stability of 98% for all three reaches. Survey data also points out that undercut banks are common, which strongly correlates with stable banks. Following the Davis Fire, approximately 400 feet of streambank within Reach 1 were found to be actively eroding or unstable. A small portion of this is likely attributed to the wildfire. These areas of instability resulted from a loss of riparian vegetation. Bank stability within Reach 1 is now estimated to be 96%, which is still very good. Rarely if ever does a natural stream have 100% bank stability.

Bank stability is not specifically recorded in either of the 1990 or 1995 stream surveys conducted on Ranger Creek. The 1995 survey states, "The section of creek which lies next to the access road needs a barrier built to prevent continued vehicle travel in the eroding area next to the stream." There is no longer access provided along the creek except where Road 4660 crosses it. A stream survey conducted in 1979 identifies 0.4 miles of eroding banks caused by logging debris deflecting flow and equipment crossing the stream channel (USFS 1979). These practices are no longer utilized because of increased awareness and implementation of the Aquatic Conservation Strategy in 1994.

Bank stability has not been measured for Moore Creek, however in walking the stream channel, areas of instability were small and often associated with the loss of vegetation resulting from fire.

The banks of Crescent Creek are very stable. Dachtler (2001) noted that bank stability was at or near 100% in reaches 1, 2, 3, 5, 6, 7, and 9. Bank instability was minimal in reaches 4, 8, 10, and 11.

Direct, Indirect, and Cumulative Effects

All Alternatives

Streambanks would not be negatively affected through implementation of any of the five alternatives. If one of the four action alternatives is selected, riparian planting of native shrubs/trees should increase the rate at which banks and riparian soils are again stabilized by vegetation along Odell Creek.

An estimated 4% of the banks along Odell Creek are unstable. Natural streambanks are rarely if ever 100% stable. Areas of instability will likely stabilize as riparian vegetation becomes reestablished. A logjam construction projected scheduled for implementation during the summer of 2004 will likely provide additional stability by reducing stream velocities and energies and by reducing shear stress.

Instream rehabilitation projects in Odell Creek would provide additional bank stability in the upper two reaches. Logjams and log structures would increase bank stability by increasing roughness, and floodplain connectivity. By increasing roughness and floodplain connectivity, stream power would be decreased and so too would be erosion potential. As floodplain connectivity is improved, suspended fine sediments can be deposited on the floodplain and near bank shear stresses reduced.

Floodplain Connectivity

Within reach 1 of Odell Creek a net loss in floodplain connectivity is assumed due to the encroachment of lodgepole pine trees onto the floodplain. It appears that the floodplain was once dominated by deciduous riparian species and was mesic and marsh like. A 1959 aerial photo of the area shows wood accumulated in significant jams. Logjams are presently not a common occurrence. Stream cleanouts and a decrease in beaver dams are the likely causes for a slight degree of channel degradation. This downcutting of the channel has likely resulted in the lowering of the water table, which has allowed lodgepole pine to become established on drier soils.

The Davis Fire burned nearly all of the lodgepole pine trees within the floodplain for Reach 1. The water table within this reach has become slightly elevated due to the fact that the trees are no longer drawing water from the water table and dead trees are falling over, increasing roughness. Floodplain connectivity will be improved as a result.

Figure 3.27 Burned Lodgepole Pine in Reach 1 of Odell Creek, October 2, 2003.

Floodplain connectivity is often analyzed as floodprone width over bankfull width. This comparison of the widths is referred to as the entrenchment ratio. The floodprone width is obtained by doubling the maximum bankfull depth in a riffle and measuring the valley width that would be inundated by a flow of that magnitude. The higher the ratio, the greater the floodplain connectivity. For example a stream with an entrenchment ratio of 1 would have a floodprone width equal to the bankfull width, as where a channel with an entrenchment ratio of 10 would have a floodprone channel 10 times wider than the bankfull channel.

In all but reach 2 (canyon reach) of Crescent Creek, the entrenchment ratio is 2 or greater. The highest ratios being in reaches 3 and 6 with ratios of 6.3 and 6.4 respectively. This indicates that peak flows are able to be released onto the floodplain and energies can be dispersed without damaging the streambed or banks.

Direct and Indirect Effects

All Alternatives

No instream work would occur under any of the five alternatives. Floodplain connectivity should improve slightly as the result of increased recruitment of additional instream woody material. Burned lodgepole pine trees will continue falling over, increasing the amount of wood and roughness in the lower reach of Odell and Moore Creeks and the upper reach of Ranger Creek.

Cumulative Effects

Floodplain connectivity should improve slightly as the result of increased recruitment of additional instream woody material. Burned lodgepole pine trees will continue falling over, increasing the amount of wood and roughness in the lower reach of Odell and Moore Creeks and upper Ranger Creek.

A log placement project scheduled for implementation in 2004 along the lower reach of Odell Creek should improve floodplain connectivity even more. Approximately 150 logs would be placed in logjam structures, which would increase roughness, decrease stream energies, protect banks, reduce sediment transport and increase floodplain connectivity. Off channel habitat will likely be more accessible as the result of the improved floodplain connectivity.

If stream rehabilitation projects are implemented in Reaches 2 and 3 of Odell Creek, floodplain connectivity would be improved. Logjam and large woody structures would be constructed to do exactly that.

FLOW/HYDROLOGY

Change in Peak/Base Flows

Odell Creek originates out of Odell Lake. The tributaries entering Odell Lake are predominantly spring fed. Snowmelt provides the remainder of the water along with upwellings located in the lake. The mostly spring fed nature of Odell Creek helps keep flows relatively stable throughout the year. USGS gauging station # 14055500 operated from 1933 to 1976 and was located about a quarter mile below the outlet of Odell Lake. The highest flow recorded by this station was 1,100 cubic feet per second (cfs) during the December 25, 1964 flood. A new gauging station operated by the state water master is located immediately upstream of the 4660 road in reach 2.

On October 6, 1998 USFS stream survey personnel measured discharge with a USGS calibrated Price AA meter. A discharge of 40.6 cfs was recorded about 200 feet below the outlet of Odell Lake. A discharge of 80.3 cfs was recorded at the new USGS gauging station in reach 2. This indicated that about 50% of summer low flow was contributed by spring fed sources. Data collected by two gauges operated simultaneously at the outflow of Odell Lake and the inflow to Davis Lake in 1976 show that the inflow to Davis Lake is approximately 50 cfs greater than the outflow of Odell Lake at any given time throughout the year. This would indicate that approximately 50 cfs is contributed to Odell Creek via springs consistently throughout the year (Odell Creek Discharge Graph 1976).

Table 3.110 Odell Creek Discharge in CFS for Indicated Recurrence Interval in Years and Annual Exceedance Probability in Percent

1.25	2	5	10	25	50	100
80%	50%	20%	10%	4%	2%	1%
171	236	345	430	556	662	781

(14055500 Odell Creek water master statistical summary for period of record 1934-1976)

Average discharge for the 43 years of record is 82.5 cfs (Odell water master statistical summary). Odell Creek flows in water year 2002 were: Total 21,388 cfs, daily mean 78.3 cfs, maximum flow of 249 cfs, minimum flow of 53 cfs, totaling 42,420 acre feet (Davis Fire Rapid Assessment). Base flows drop in early summer following the installation of the rock weir at the outlet of Odell Lake.

Direct and Indirect Effects

All Alternatives

Any changes to peak and base flows will be minimal, and the result of the fire, not the action alternatives. Peak and base flows may be altered slightly as a result of the loss of vegetative cover until mature vegetation is reestablished across the landscape. As the result of lost vegetation due to the Davis Fire, precipitation will fall directly to the forest floor without being intercepted or retained in the canopy. As a result, evapotranspiration

would be reduced. More water will likely be delivered to the ground and it will likely happen more quickly than in pre-fire conditions, again due to the loss of vegetation. Delivering more water to the system more quickly typically results in increased peak flow and decreased base flows as water is quickly passed through the system over a short period of time rather than being stored and released more gradually throughout the year. The more roughness that is left on the landscape in the form or logs or woody material, the higher the likelihood that surface runoff would be inhibited. Course woody debris and snag requirements for wildlife needs should be adequate to inhibit surface flows. Also, maximum riparian reserve buffers would be maintained to benefit Aquatic Conservation Strategy and Riparian Habitat Conservation Area Objectives.

However, because the project area is at the downstream end of what is basically a closed system, (due to the lava flow), the spatial area of increased flows is limited in extent (see table 3.108 – percent of watershed in fire perimeter). Ranger Creek may experience a slight increase, however, being spring-fed and only a mile and a half in length, flows should remain fairly constant. Moore Creek flows out of a lake within an Inventoried Roadless Area and is subterranean most of the year within the project area. Less than one mile of channel passes through the project area. It is doubtful that Moore Creek would experience any increase in peak flow, and there will definitely be no decrease in base flow. Odell Creek could experience slight increases in peak flow, however being at the end of the stream channel and in a broad, flat valley, this is not expected. Odell Creek flows out of Odell Lake and collects flow from a couple of spring fed tributaries outside of the project area.

Cumulative Effects

The stream rehabilitation projects that may occur within the Odell watershed may result in a decrease in peak flows and an increase in base flows over time. Through increasing roughness and floodplain connectivity the water table may be raised slightly within the valley, allowing more water storage subsurface. Less water would be transported as surface flow during high water times and rather stored and released more gradually throughout the year.

The removal of the weir at the outlet of Odell Lake may result in decreased base flows in Odell Creek. If the weir does successfully store water, in the absence of the weir late summer and early fall discharge would likely be decreased as that flow would have been passed earlier in the year and not stored for release in the fall. This would however be of benefit to Odell Creek as the cooling effect of the spring fed tributaries would be more substantial if the amount of warm surface water from Odell Lake were decreased. As is, the weir stores water on the surface of Odell Lake, which is then heated and released later in the summer and fall and may artificially supplement the flow during that time of year. The weir also reduces the amount of flow coming down Odell Creek during the early summer, when water storage is taking place.

Therefore, from a cumulative perspective, proposed activities in addition to foreseeable actions have the potential to lower the overall temperature in Odell Creek from the existing condition.

Increase in Drainage Network

There has been little if any increase in drainage network length as a result of human activity. If lateral migration were occurring, unstable banks and active erosion would evidence it. Since bank stability in Odell Creek has been estimated to be at 98% in Reaches 2 and 3 and 96% in Reach 1, bank stability within this reach does not appear to be an issue. High road densities within these subwatersheds have not resulted in increased 1st order streams likely because of the highly porous soils. Channeled or road-routed water is quickly absorbed and not carried over the surface.

Bank erosion for the most part is isolated to an area along approximately 400 feet of burned area in Reach 1 and along East Davis Campground at the confluence with Davis Lake.

Bank erosion along Ranger Creek is limited to a small area adjacent to FS road 4660 where the old Windigo Trail crossed the stream channel.

Direct, Indirect, and Cumulative Effects

All Alternatives

There is likely to be no increase in drainage network as the result of implementing any of the five alternatives. Bank stability within Odell Creek is estimated to be at 96%. Ranger and Moore Creeks have very little if any areas of bank instability. The relatively high volume of instream wood and future wood recruitment are providing roughness and bank protection. No instream wood will be removed. With the wood in place, stream energies are not sufficient enough to cause additional instability.

Future instream wood placement projects along with natural recruitment of fire killed lodgepole pine trees should result in increased roughness and decreased erosion potential. If the projects are implemented and additional wood is recruited, bank stability should be increased.

WATERSHED CONDITIONS

The watershed condition is essentially assessed using factors that cause disturbance. Although an imperfect gauge to watershed health, it can be used as a comparison between alternatives to their potential to affect short and long term functioning condition. For example, past vegetation management may have an effect on overall watershed health due to the well drained soils and poor correlation to increased water flow. However, it can be used comparatively in conjunction with other factors to gauge the effects of active versus passive management.

Road Density and Location

Open road densities within the Odell Creek Riparian Reserves are 2.0 miles per square mile (USFS 1999). As part of the design of the action alternatives, 6 miles of road will be decommissioned within the Davis Lake and Odell Creek subwatersheds. Most of these roads lie adjacent to Odell Creek in the lodgepole flat (USFS 2003). An additional 22 miles of road within the project area are proposed for closure. Table 3.124 on the following page displays the open road densities by subwatershed for all alternatives.

Table 3.111 Open Road Density by Subwatershed – Common to All Action Alternatives

Subwatershed Name	Subwatershed Number	Total Road Density (Mi/Mi^2)*	Current Open Road Density** Alternatives A, B, C, and E
Odell Creek	170703010202	6.2	3.35
Moore Creek	170703010203	1.52	0.97
Davis Lake	170703010204	5.47	3.2
Davis Creek	170703010206	4.2	3.24
Wickiup	170703010207	5.88	4.7
Middle Crescent Creek	170703020206	5.2	3.61
Lower Crescent Creek	170703020207	4.74	4.25
Hamner Butte	170703020301	4.93	3.71

*These include all system roads, open and closed status.
** May include roads on private lands, and does not include water

Direct and Indirect Effects

All Alternatives

Closures of 106 miles of roads within the Davis Management Area are to remain closed with the exception being for administrative use. An additional six miles of road have been identified to be obliterated at a future date when funding becomes available. While road closures are not the same as road obliterations, road closures will reduce the amount of use on roads and reduce access to dispersed sites along lower Odell Creek. Forest Service road 4660600, which parallels lower Odell Creek, is among the closed roads. This road provided access to many dispersed sites along Odell Creek. Reducing vehicular access will benefit riparian recovery by reducing trampling and reduce bank erosion at those sites.

Alternative A

Under the No Action Alternative, road densities would remain unchanged. Road densities would remain well above 2.5 miles per square mile which has been identified by Rieman et al (1997) as a threshold for strong populations of bull trout. Temporary road construction to facilitate salvage and fuels reduction would not occur.

Alternatives B, C, D, and E

Road density has been linked to a series of negative effects to the aquatic environment including, increasing drainage miles and altering water chemistry. Snyder et al. (1975) found precipitation runoff leached nutrients from the exposed soil, and provided increased nutrient concentrations directly to the stream. Wemple et al. (1996) demonstrates how road systems can increase peakflow and that drainage ditches can form gullies that lead to streams. Newly created temporary roads using native surface as road beds for harvesting would provide this runoff potential and increased nutrient loading as Snyder et al. (1975) discussed to streams until these roads are restored to a natural condition after harvest and post harvest treatments occur. Rieman et. al. (1997) has shown that within colder subwatersheds (mean annual air temperature <5.1°C), bull trout populations were reported as strong nearly seven times more frequently in those with less than 2.5 miles of road per square mile than those with more. Due to the highly porous soils, implementation of BMPs, and generally flat topography, it is not anticipated surface flows would carry sediment or nutrients to the stream or lake. The 4660 road crossing at both Odell and Moore Creeks is a double lane gravel road. This road can be very dusty during summer months. Heavy and continuous haul traffic would increase the amount of airborne dust/dirt particles and increase the amount of delivery to the stream channel.

Cumulative Effects

The Roads Analysis recommends 28 net miles of road closures. It is reasonably foreseeable that these closures will take place. In the interim, a closure order is in effect that restricts public use to certain roads. As obliterated and closed roads (both system and temporary) begin to seed in and revegetate, there may be a reduction in the potential delivery of sediment and an increase in the duration of input of water to the streams and lake during storm events as waters more readily infiltrate the soil rather than moving downslope as surface flow. Peak flows could be reduced in both frequency and magnitude as a result of storing water subsurface rather than quickly delivering runoff to the stream. Closing or obliterating 28 net miles of road within these subwatersheds would be a beneficial activity for stream health. Additionally some of the roads identified for closure provide access to dispersed campsites and fishing opportunities along Odell Creek. Closing these roads would reduce the amount of sediment input contributed from their continued use, protect riparian vegetation by no longer providing access to dispersed streamside campsites and potentially reduce harassment from anglers.

Disturbance History

The Wickiup 5th field Watershed is approximately 131,858 acres and lies entirely within federal ownership on the Deschutes National Forest. The Odell Watershed Analysis covers the part of this watershed on the Crescent Ranger District, and the Browns/Wickiup Watershed Analysis the part on the Bend-Ft. Rock Ranger District (USFS 1999; USFS 1997). According to the Odell WA, 78% of the stands analyzed were mid or late successional multi-storied. Recent vegetation management to thin over-crowed stands in the area includes Seven Buttes and Seven Buttes Return. A 1930 Bend Bulletin article describes a 5,000 acre fire which burned between Davis and Odell Lakes. The Davis Fire of 2003 covered more than 21,000 acres within eight subwatersheds (in 3 5th field watersheds – see table 3.123). The percentage of these subwatersheds affected by the fire is listed below.

Table 3.112 Sixth Field Watersheds Affected by Davis Fire

Watershed Unit Number	6th Field Watershed Name	Acres	% of subwatershed within burn perimeter
170703020206	Middle Crescent Creek	18,051	1 % *(no streams)*
170703020207	Lower Crescent Creek	26,964	2 % *(no streams)*
170703020301	Hamner Butte	13,360	27 % *(no streams)*
170703010202	Odell Creek	13,830	23 % *(Odell Creek)*
170703010204	Davis Lake	22,505	37 % *(Ranger Creek)*
170703010206	Davis Creek	17,639	7 % *(no streams)*
170703010207	Wickiup	26,963	17 % *(no streams)*
170703010203	Moore Creek	14,748	<1 % *(Moore Creek)*

Aerial retardant drops from the Davis fire show a drop occurring across Odell Creek at approximately river mile 1.5, however there was no evidence of this on the ground. The effects of these retardant drops are described in the Soils section, beginning on page 3-85.

Table 3.113 Past Harvest Activity and Existing Detrimental Soil Conditions within Odell Creek and Davis Lake Subwatersheds

Subwatershed (acres)	Acres w/past Harvest Activity (% of Subwatershed)	Acres of roads (% of Subwatershed)	% Subwatershed detrimental (acres)*
Odell Ck (13,830)	3,559 (26%)	268 (1.9%)	7% (980)
Davis Lake (22,505)	5,498 (24%)	345 (1.5%)	6.4% (1,445)

From Davis EIS soils report (Sussmann, 2003).

*Detrimental acres were calculated as an average of 20% of past activity unit acreage plus existing road acreage within each subwatershed. Detrimental acreage within past activity units ranges from 10 to 30% depending on harvest prescriptions and number of entries.

Table 3.114 Proposed Harvest by Subwatershed

Subwatershed	Harvest Acres				
	Alt B	Alt C	Alt D	Alt E	Small Fuels Treatment
Davis Creek	31.5	31.5		31.5	282
Wickiup	796.5	796.5	776	590	550
Hamner Butte	1176	1176	269	422	49
Lower Crescent Creek	42	42	0	0	65
Middle Crescent Creek	34	34	0	0	35.5
Odell Creek	841	841	0	461	2
Davis Lake	3436	3436	0	1955	243
Moore Creek	0	0	0	0	52
Total	**6357**	**6357**	**1045**	**3459.5**	**1278.5**

The subwatersheds that have definable stream channels are: Odell Creek, Davis Lake and Moore Creek. The Moore Creek subwatershed has only 60 acres inside the fire perimeter and no proposed timber harvest and will not be discussed further in terms of EHA. The Odell Creek subwatershed had a pre-fire EHA of 16% and post-fire of 30.5%. The Davis Lake subwatershed had a pre-fire EHA of 14.7% and post-fire of 42%.

Recent harvest activity within the Odell Creek and Davis Lake subwatersheds covers approximately 26% and 24%, respectively, of the total subwatershed acreage (these subwatersheds include the only two perennial streams in the project area). Harvest prescriptions throughout the area range from 1970 through 1990 era clearcut or shelterwood/final removal prescriptions to highly variable selection cut prescriptions that occurred as early as the 1960s. Activity prescriptions occurring in the last decade are primarily commercial thins at relatively low volume levels in order to maintain Nesting, Roosting and Foraging habitat. Detrimental soil disturbance levels measured in past activity areas on the district and forest generally range from 10 to 40%, depending on harvest prescriptions, volume removed and the number of entries within a given unit area (USFS 1993-2001).

Direct and Indirect Effects

Alternative A

No additional disturbance would occur. There would be no commercial timber harvest, reforestation or small fuels reductions. Also, planting of conifer trees and its potential beneficial effect to long term watershed function would not occur.

Alternatives B and C

The major disturbance to the area was the Davis Fire of 2003. All proposed commercial activities would occur only in areas with complete mortality resulting from the fire. All live trees (except for small diameter thinning for fuels reduction) would remain to provide some measure of water interception and evapotranspiration. All action alternatives would increase the amount of ground disturbance as the result of commercial logging activities and small fuels reduction. Ground based timber harvest would include skidding trees to landings and temporary road construction. See table 2.6 for the amount of logging systems by alternative. Some loss of soil productivity or soil displacement would occur (see table 3.9, Predicted Detrimental Disturbance). Units identified for advanced harvest systems (helicopter or skyline logging) would experience less disturbance as no

road construction or skidding would occur. Planting of conifer trees to accelerate future canopy cover would occur on 8,400 acres.

Alternative D

Total disturbance area would be limited to 2,795 acres, 1,045 of which would be commercial harvest; the remainder would be due to small fuels reduction activities. The major disturbance to the area was the Davis Fire of 2003. All proposed commercial activities would occur only in areas with complete mortality resulting from the fire. All action alternatives would increase the amount of ground disturbance as the result of commercial logging activities and small fuels reduction. Ground based timber harvest would include skidding trees to landings and temporary road construction. Some temporary loss of soil productivity would occur (see Soils section). Reforestation would occur on 2,030 acres.

Alternative E

Commercial timber harvest would include all skyline and all helicopter units identified in Alternative C, plus units 412, 413, 415, 417, and 418 along FS road 46 as helicopter units. Units 5 and 10 are deferred from salvage harvesting in Alternative E. Hazard trees would be removed along major roads as ground units where timber harvest would be limited to the removal of hazard trees along the road corridor. Reforestation would occur on 3,910 acres. See Soils section for an estimate of temporary loss of soil productivity.

Cumulative Effects

Alternative A

Given the fire regime for east side of the Cascade Mountain range, it is likely subsequent fire could reburn across this landscape in the event that fuel loads across the landscape are not reduced as suggested under the proposed action. A reburn would likely kill newly established vegetation and reset/delay the process of recovery. High severity fire could be substantial where a large portion of the soil surface is directly overlain by large woody material (Brown et al, 2003).

Alternatives B, C, and E

While there would be a component of commercial timber harvest associated with any of these four alternatives, those activities would occur only within areas of 100% fire mortality. Therefore, the disturbance (fire) has already occurred and harvest activities would not be increasing the area of disturbance. Treating small diameter fuels and creating strategic protection to high value resources in combination with future application of prescribed fire has the potential to lessen the severity of subsequent wildfire events (Brown et al, 2003).

Alternative D

Cumulative effects to watershed disturbance are similar to those described under Alternative A.

Riparian Reserves

There has been a considerable change in riparian composition along the length of Ranger Creek, Davis Lake, the lower 3,000 feet of Moore Creek and the lower 2 miles of Odell Creek following the Davis Fire. The Davis Fire has killed nearly all of the lodgepole pine trees that had encroached into the riparian area and floodprone flats of these streams and the lakeshore. Fire exclusion, inadequate floodplain function, and interaction with peak flows are the likely reasons that lodgepole pine trees were able to become established here. A slight degree of channel

degradation has likely occurred in Odell Creek which may have lowered the water table and reduced the stream's ability to release peak flows onto the floodplain. Once floodplains and riparian flats were no longer being inundated by peak flow events and an elevated water table, lodgepole pine trees could become established on the now drier sites and out compete the grasses/forbs and deciduous riparian species.

Several riparian species including willow, mountain alder, serviceberry, bog birch and snowberry have been found re-colonizing the area within a couple months of the fire. Riparian grasses and sedges have also recovered quickly.

The riparian reserve around Davis Lake is typically comprised of ponderosa pine dry and lodgepole dry PAG types.

Direct and Indirect Effects

Alternative A

Riparian areas would continue to recover naturally from resprouting and natural seed dispersal.

Trees within the Davis Lake riparian reserve tend to be large ponderosa pine. Although the consumption of live vegetation, organic litter, and coarse wood by the fire has reduced the amount and function of these components within the buffer corridors in the short-term, their return is expected to occur at a steady rate over the next few years. Live vegetation has returned in various forms and amounts from the re-sprouting of burned perennials and residual annual and perennial seed sources. Fine organic litter in the form of needles from burned trees has fallen to the soil surface in some areas and more will be contributed from the annuals an d perennials that have begun to return. Additional coarse wood has been contributed in some areas by fire-killed trees that have subsequently been windthrown to the ground, with many more likely to fall in the next few years. The function of the riparian buffers as sediment traps is expected to steadily increase as vegetative and organic components provide effective ground cover capable of intercepting raindrops before they hit bare mineral soil and reducing the energy of overland flows generated during storm events. The relatively flat topography and high infiltration rates of the soils present in the area also reduce the risk of these mechanisms from generating sediment and actually delivering them to the stream or lake waterbodies in the project area. Downed wood will intercept and inhibit the delivery of mobilized sediment to the water body. Downed woody will also be effective in retaining topsoil, which will aid the quicker recovery of riparian vegetation.

Alternatives B, C, D, and E

Riparian planting would be limited to native, deciduous species along the lower 1.5 miles of Odell Creek. Small fuels treatment would occur on approximately 60 acres along the western shoreline of Davis Lake. Riparian reserve recovery would occur as the result of resprouting and natural seed dispersal. Benefits of leaving dead trees in the riparian reserve are the same as described for Alternative A, as no commercial harvesting will occur in the 300 foot riparian reserves.

Cumulative Effects

All Alternatives

Riparian areas will likely recover and provide all of the functions and features of a healthy, functioning riparian area within the next 300 years. Deciduous vegetation should recover much more quickly, within the next 5 to 10 years, while large conifers will take more time to grow.

The implementation of stream rehabilitation projects should accelerate the rate of recovery and sustainability of a grass and shrub dominated riparian area along Odell Creek. The rehabilitation projects should improve floodplain connectivity and maintain a slightly elevated water table, providing more ideal growing conditions for riparian dependant vegetation.

Disturbance Regime

Originating from Odell Lake, with up to 50% of summer flows being contributed by springs, flows within Odell Creek are relatively stable and predictable. Scour events and debris torrents are not common occurrences within this system. Peak flow events generally occur in the spring as the result of snowmelt. Rain on snow or summer thunderstorm events are capable of producing sediment transport to the stream despite the rapid infiltration rates of the surface mineral soil component. Soil particles can become detached and mobilized in areas which are not adequately vegetated or when infiltration rates are not fast enough to keep up with the volume of water present on the surface. The following table displays the probability that discharge from Odell Creek would reach a certain amount. For example, for a 100-year event, there is a 1% annual chance that flows could discharge 781 cfs.

Table 3.115 Odell Creek Discharge in CFS for Indicated Recurrence Interval in Years and Annual Exceedance Probability in Percent

Recurrence Interval (years)	1.25	2	5	10	25	50	100
Annual Exceedance Probability	80%	50%	20%	10%	4%	2%	1%
Discharge (CFS)	171	236	345	430	556	662	781

(14055500 Odell Creek water master statistical summary for period of record 1934-1976)

The Davis Fire of 2003 burned roughly 21,000 acres, including a considerable portion of the lower Odell Creek watershed, nearly 2 miles along Odell Creek and 1 mile along Ranger Creek (see table 3.108 showing the percent of each subwatershed affected by the Davis Fire). This disturbance has significantly altered the vegetative community along these streams. Nearly all of the lodgepole pine that grew in the riparian areas has been killed. Grasses, forbs and deciduous trees were burned as well, but are showing rapid recovery. The diminished stream shade will likely result in increased solar radiation and possibly higher stream temperatures during summer months. Trees killed by the fire are expected to fall and contribute notably to the amount of instream woody debris. The increased amount of in channel woody debris would provide additional stream cover and help offset the loss of shade provided by trees. Recovery of riparian plant species would likely occur relatively quickly (<10 years). Grasses were found to be growing within a week of when the fire burned over the area. Willow clumps also displayed new growth within a matter of weeks following the fire. Establishment of deciduous riparian species will probably be improved as the result of reduced competition from encroaching lodgepole pine. Willow, mountain alder, bog birch, serviceberry and snowberry are becoming re-established across the floodplain.

Peak flows may increase slightly due to the reduction in vegetative cover. Evapotranspiration will likely be reduced, as precipitation will fall directly to the forest floor rather than being intercepted by foliage. Infiltration rates will remain high; however storage of rain and snowfall will probably be reduced. Given that this area of disturbance is at the lower end of a somewhat closed system, increases are expected to be minor.

Direct and Indirect Effects

All Alternatives

None of the five alternatives are expected to directly affect the disturbance regime as it relates to probability to increase peak flow events in any of the eight subwatersheds. There may be indirect effects to the disturbance regime as the result of implementation of any of the four action alternatives. A significant aspect of the four action alternatives is to reduce the amount of fuel loading in order to create conditions where prescribed fire can be introduced into the developing forest and to reduce the probability of another large scale fire burning

across the landscape. Through timber harvest and small fuels reduction strategies ranging in scale between Alternatives B through E, fuel loading would be reduced. Treatment areas are designed to give a mosaic pattern to the landscape and allow a higher probability for fire officials to contain or limit the area of a future burn. Fuel loading site estimates for the mixed conifer dry PAG units in the Davis Fire indicate that 90 tons per acre will remain on the landscape following commercial harvest.

Cumulative Effects

All Alternatives

While there would be a component of commercial timber harvest associated with any of these four alternatives, those activities would occur only within areas of 100% fire mortality. Therefore, the disturbance (fire) has already occurred and harvest activities would not be increasing the acreage of disturbance.

Effects Summary

Table 3.116 Summary of Effects Determination for Threatened, Endangered, and Sensitive Fish Species

Species	Status	Occurrence	Effects Determination Alternative A	Effects Determination Alternatives B, C, D, and E
Columbia River Bull Trout *(Salvelinus confluentus)*	Threatened	Habitat Documented Species Documented	No Effect	May Affect, Not Likely To Adversely Affect
Interior Redband Trout *(Oncorhynchus mykiss ssp.)*	Sensitive	Habitat Documented Species Documented	No Impact	May Impact Individuals or Habitat, but Will Not Likely Contribute to a Trend Towards Federal Listing or Cause a Loss of Viability to the Population or Species

The Seven Buttes Return, Five Buttes Interface, Crescent WUI and Charlie Brown vegetative management projects when combined with the Davis Fire and Davis Fire Recovery have cumulatively decreased the amount of vegetative cover on the ground and soil disturbance. With decreased vegetative cover, water storage is typically decreased, as more precipitation is able to fall directly to the forest floor and not be retained in the canopy and then evaporated back into the atmosphere. This condition typically leads to increased volumes of sediment mobility. However, given the topography and geology of the area, this sediment is not mobilized and delivered to the stream or lake bodies. Water is quickly absorbed on the slopes and transported downslope subsurface. This is evidenced by the lack of definable stream channels on the hill slopes. Stream channels and surface flow are only found in the lacustrine valley bottom of Davis Lake or stream which originate outside the area and flow into Davis Lake. Moore Creek and Odell Creek originate as lake outflow from Bobbie and Odell Lakes respectively.

Project Design Criteria for Bull Trout and Essential Fish Habitat for Chinook Salmon

Listed below are PDC derived from PACFISH, INFISH, the Northwest Forest Plan, Aquatic Conservation Strategy Objectives, and the Deschutes and Ochoco National Forests Land and Resource Management Plans. These criteria focus on habitat alterations and disturbance effects, and are designed to protect and maintain high channel complexity and stability, abundance and diversity of side channel habitats, water quality, low levels of fine sediment, in-stream wood and wood recruitment, natural flow regimes, and open historic migratory corridors. These criteria apply to watersheds in which bull trout and steelhead trout are known or suspected to occur and for watersheds that have Essential Fish Habitat (EFH) for spring chinook salmon (including unoccupied historic range for chinook).

The criteria for salmonids do not replace existing direction and requirements in PACFISH, INFISH, any biological opinions, and LRMP/RMPs. All provisions of these documents continue to apply. The provisions of interagency conservation agreements also continue to apply. Therefore, projects must contribute toward attainment of appropriate Riparian Management Objectives (RMOs), as defined in PACFISH and INFISH, and be consistent with appropriate biological opinions. Projects cannot retard attainment of "properly functioning" condition of relevant indicators (as described within NOAA Fisheries and FWS matrices of pathways and indicators).

Table 3.117 lists the project design criteria (PDC) for bull trout and essential fish habitat for spring chinook salmon. The table also shows which criteria apply to the Davis Salvage Project. The Fisheries Specialist Report includes a complete description of those PDCs that apply. All action alternatives comply with those PDS that apply to the project. PDC E1 calls for increases in EHA (equivalent harvest area) watershed values if the baseline is greater than 25%. Although some subwatersheds exceed the 25% value, the Davis Fire Recovery Project meets this PDC because the EHA will not be increased by salvage. Salvage harvest would occur in areas already disturbed by the fire (see page 3-121 for the EHA values across the project's stream-bearing subwatersheds).

Table 3.117 Aquatics Projects Project Design Criteria Compliance Checklist

Project Design Criteria Compliance Checklist	Applies to project (Yes/No)	Project Complies (Yes/No)
A.1.a Large wood removal- meets wood criteria for RR/RHCA for site	Y	Y
A.1.b. Large wood removal -meets instream LWD objectives in WA	Y	Y
A.2.a. Large wood- Hazard tree felling instream avoids spawning fish/ redds	Y	Y
A.2.b. Large wood- Habitat assessment for moving wood for boating	N	
A.2.c. Large wood- Hazard trees topped for wildlife are retained	Y	Y
A.2.d. Large wood- Hazard tree removed for facility operations	Y	Y
B.1. Water Temp- no measurable increase in stream temp due to decreased shade	Y	Y
B.2. Water Temp- no increase in temp due to change in flow	Y	Y
C.1.Sediment- no off road, ground based machinery in RR/RHCA	Y	Y
C.2. Sediment- no landings in RR/RHCA	Y	Y
C.3. Sediment- no fireline construction in RR/RHCA	N	
C.4. Sediment- ignite burns outside RR/RHCA (except hand piles)	N	
C.5. Sediment- pile burning at least 50 ft. outside of riparian veg depending on slope	Y	Y
C.6. Sediment- temp roads outside of delivery zones and meet BMPs	Y	Y
C.7. Sediment- commercial use, blading, hauling does not add to siltation	Y	Y
C.8. Sediment- snow plowing drains runoff away from streams	Y	Y
C.9. Sediment- class III, IV culverts meet BMPs during/after construction	Y	Y
C.10. Sediment- no in-water digging that disturbs spawning/rearing substrate	N	
C.11. Sediment – control road traffic during wet periods	Y	Y
D.1. Bank Stability- do not raise or lower water levels	N	
D.2. Bank Stability- no veg cover reduction causing instability ($\geq$ 90% stable)	Y	Y
E.1. Cumulative Effects- < 15% CHA/EHA, no increases if baseline >25%	Y	Y
E.2. Cumulative Effects – Road density to not increase above 2.5 (Des) or 3.0 (Och)	Y	Y

Project Design Criteria Compliance Checklist	Applies to project (Yes/No)	Project Complies (Yes/No)
F.1. Timing-seasonal restrictions in RR/RHCA to eliminate impacts	Y	Y
F.2. Timing- Bull trout 8/15 -5/15, steelhead 2/15-7/15(3/15 BLM)	Y	Y
F.3. Timing - Survey prior to instream work in restricted times for hazard trees	Y	Y
G.1. Livestock Exclusion- bull trout 8/15-5/15	N	
G.2. Livestock Exclusion- steelhead 2/15 -7/15	N	
G.3. Livestock Utilization- set on most palatable species within DMA	N	
G.4.a. Livestock Monitoring - 100% of category 1, min of 35% category 2 pastures	N	
G.4.b. Livestock Monitoring- 1st when stock in pasture, 2nd end of growing	N	
G.5.a. Livestock Removal- terrace/dry meadows stubble height utilization	N	
G.5.b. Livestock Removal – Kentucky Bluegrass dominated terraces	N	
G.5.c. Livestock Removal- stock moved at >10% streambank alteration	N	
G.5.d. Livestock Removal- stock moved at change of preference to woody	N	
G.5.e. Livestock Utilization- utilization of Greenline vegetation	N	
G.5.f. Livestock Utilization - Wet and Moist meadows utilization	N	
G.6. Livestock - Standards are not met, then adjustments to grazing are made	N	
H.1. Fish passage- perform work in dry channels before water is turned on	N	
H.2. Fish passage- all new and reissued permitted diversions/withdrawals have screens	N	
H.3. Fish passage- maintain passage on bridges and culvert projects	N	
I.1. Water Drafting – Drafting in streams with at least 10 cfs	N	
I.2. Water Drafting - Drafting must meet NOAA fish screen criteria	N	
I.3. Water Drafting – Short term withdrawals	N	
I.4. Water Drafting – Do not draft out of steelhead waters	N	
K. Land Exchanges that include streams for listed species are not covered in this BA	N	
L. No herbicide use - bull trout and steelhead-bearing subwatersheds, or non-steelhead RHCAs.	N	

EHA – Equivalent Harvest Area
CHA – Cumulative Harvest Area
RR – Riparian Reserve
RHCA – Riparian Habitat Conservation Area
DMA – Designated Monitoring Area
BA – Biological Assessment
LWD – Large Woody Debris
WA – Watershed Analysis
NOAA – National Oceanic and Atmospheric Administration

Water Quality

Introduction

The Davis Fire Recovery Project area lies in the Upper Deschutes and Little Deschutes Sub-Basins. It is in the Wickiup (HUC 1707030102), Middle Deschutes (HUC 1707030203), and Crescent Creek (1707030202) Watersheds. The Davis fire occurred in eight subwatersheds (table 3.118).

The majority of the subwatersheds in the project area were analyzed in the Odell Watershed Analysis (USFS 1999). The Odell Watershed Analysis identified key trends for the watershed as well as watershed restoration objectives. Odell Creek subwatershed is designated as a Tier 1 Key watershed as defined by the Northwest Forest Plan. Tier 1 watersheds contribute directly to the conservation of at-risk stocks of resident fish species and also serve as refugia for maintaining and recovering habitat for these at-risk species.

Table 3.118 Area of Subwatersheds within the Fire Perimeter

Watershed (5th Field)	SWS Name (6th Field)	SWS HUC #	SWS Acres	Percent of Subwatershed in fire area
Wickiup	Odell Creek	170703010202	13,830	22%
	Moore Creek	170703010203	14,748	<1%
	Davis Lake	170703010204	22,505	36%
	Davis Creek	170703010206	17,638	7%
	Wickiup	170703010207	26,963	17%
Middle Little Deschutes River	Hamner Butte	170703020301	13,360	27%
Crescent Creek	Middle Crescent Creek	170703020206	18,051	<1%
	Lower Crescent Creek	170703020207	20,144	2%

Management Direction

Clean Water Act

The State of Oregon, as directed by the Clean Water Act and the Environmental Protection Agency, is responsible for the protection of rivers and other bodies of water in the public interest. Oregon Administrative Rules, Chapter 340 list the beneficial uses in the project area as:

- Salmonid Rearing
- Salmonid Spawning
- Resident Fish and Aquatic Life
- Water Contact Recreation and Boating
- Aesthetic Quality
- Water Supply

The State is required by the Clean Water Act, Section 303(d), to identify waters that do not meet water quality standards. Odell Creek is the only water body within the Davis Fire Recovery Project area on Oregon's list (303(d) list). It is listed for exceeding summer water temperatures for salmonid rearing (17.8° C) and spawning (12.8° C).

States are required to develop Total Maximum Daily Load (TMDL) allocations, which include Water Quality Management Plans (WQMP) for 303(d) listed waters. Most of the project area lies within the Upper Deschutes Subbasin and a WQMP is scheduled for completion in 2006. The entire project area is within the Upper Deschutes Basin, for which a WQMP is under development and scheduled for completion in 2006.

The Forest Service responsibilities under the Clean Water Act are defined in a 2002 Memorandum of Understanding between DEQ and the Forest Service. The MOU designates the Forest Service as management agency for the State on National Forest System Lands.

The Best Management Practices (BMP) are a requirement of the Clean Water Act which required the State of Oregon to develop a state-wide water quality management plan and to set standards for water quality. BMPs that apply to this project are identified in Chapter 2 under Mitigation and Resource Protection.

Northwest Forest Plan

The Deschutes National Forest LRMP was amended in 1994 by the Record of Decision for Amendments to the Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl (Northwest Forest Plan). An essential piece of the Northwest Forest Plan is the Aquatic Conservation Strategy (ACS) which "was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on public lands." (USFS 1994, B-9). The Odell Creek 6th field watershed is a Tier 1 Key Watershed, which contributes directly to the conservation of the threatened bull trout and resident fish populations. The NWFP specifies standards and guidelines for Key Watersheds and Riparian Reserves that prohibit or regulate activities that retard or prevent attainment of the ACS Objectives. All action alternatives comply with the Riparian Reserve and Key Watershed standards and guidelines (see pages 3-296 for a discussion of each).

Existing Condition

Climate

Large moist air masses accumulate over the Pacific Ocean and move west to east over Oregon crossing the coast mountain range and the higher Cascade Mountain range before reaching the analysis area. As much as 80 inches plus can fall on the crest of the Cascades as clouds reach their highest elevation. Precipitation rates drop drastically from the crest of the Cascades east into the analysis area and range from 25 to 50 inches. Elevations in the analysis area range from 4,000 feet above mean sea level (msl) to 7,098 msl. As a result, precipitation falls mostly as snow between November and May with average accumulations of three to five feet. Another somewhat uncommon winter storm comes from the southwest and can produce warm winds and rain that reduce the snow pack quickly in a short time, causing increases in peak flows. Summer thunder storms can produce large amounts of rain in a short time; resultant runoff is absorbed into the soil. These systems are fast moving, usually come from the south or southwest, and can produce rainfall amounts of 2 to 3 inches per hour.

Geology

The Central Cascade area is relatively young in geologic time formed by volcanic eruptions in the last 5 thousand to 15 million years over much older volcanic material, called the Old Cascades. Hamner Butte and Davis Mountain are strato volcanoes and Ranger Butte is a cinder cone. These are areas of relief with minor amounts of slopes over 45 percent and the majority of the slopes range between 5 to 25 percent. There is no evidence of landslides in this landscape. A major event that occurred 7,700 years ago was the eruption of Mt Mazama. This eruption covered the entire analysis area with ash and pumice with depth up to ten feet (Larsen 1976).

Streamflow

Due to the depth of the high porosity pumice soils and glacial outwash, stream density is very low in the analysis area. There are two perennial streams (Odell and Ranger Creeks), and one ephemeral stream (Moore Creek). There is also an unnamed intermittent/ephemeral stream located inside the fire perimeter to the southeast of East Davis Campground. This unnamed tributary to Davis Lake is approximately 3 miles long and originates just to the north of the FS 4660 road. Table 3.109 illustrates stream density inside the fire perimeter by 6th field watersheds.

Odell Creek, the largest stream in the project area, originates at Odell Lake and flows approximately 7.5 miles to Davis Lake. Ranger Creek originates from springs and flows approximately 1 mile into Davis Lake. Both Ranger and Odell Creeks enter Davis Lake on the south side. Moore Creek is intermittent in the lower reaches as it enters Davis Lake and a perennial stream further up the drainage towards Bobby Lake. Flows from Moore Creek occur during spring melt-off and stream flow usually stops in the first part of June.

There are other draws that originate on the west and east sides of Davis Mountain, and Hamner Butte, and west of Ranger butte, but these draws show no evidence of stream flow and have no aquatic vegetation associated with them. This probably is a result of the depths of pumice deposited in draws during the eruption of Mt. Mazama.

Volcanic activity that occurred in the Holocene closed the outlet to Davis Lake making it a topographically closed basin (Phillips 1968). The total area that drains into Davis Lake is 98 mi^2. It is assumed that water leaving Davis Lake travels subsurface to Wickiup Reservoir. The following annual water budget of Davis Lake is from *The Hydrology of Crater, East and Davis Lake* (Phillips 1968):

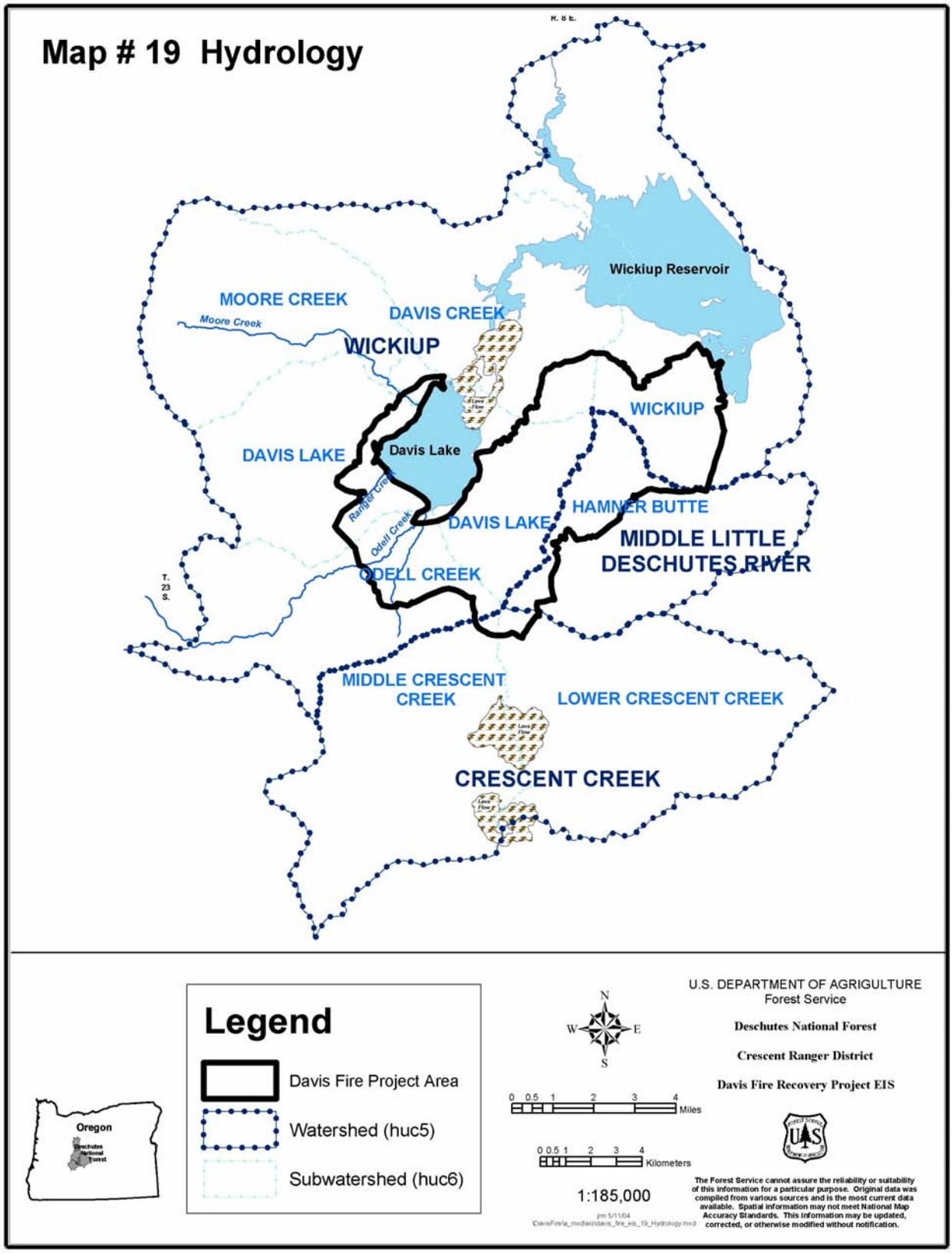
1. In-falling precipitation, 36 inches depth (8,000 acre feet)
2. Inflow from Odell Creek and tributaries 150 cfs (109,000 acre feet)
3. Evaporation loss 30 inches (8,000 acre feet)
4. Outflow by seepage, 150 cfs (109,000 acre feet)
5. Observed lake level has ranged from a minimum of 4,375.9 feet on October 20, 1942, to a maximum 4,393.2 feet high water mark in 1957. Total contents is approximately 45,000 acre feet.

A very small portion of the fire occurred in Lower Crescent Creek and Middle Crescent Creek subwatersheds. The portion of the fire within these subwatersheds is located at the top of Hamner Butte, where drainage densities are nonexistent (Map #19 and table 3.119).

Table 3.119 Acres of Stand Replacement Fire Intensity and Stream Density by Subwatershed

Subwatershed	Acres of Moderate or High Intensity Fire*	Stream Density in Fire Perimeter (mi/mi$^{2)}$
Odell Creek	2,305	.34
Moore Creek	50	.008
Davis Lake	6,087	.04
Davis Creek	1,050	0
Wickiup	3,430	0
Hamner Butte	2,541	0
Middle Crescent Creek	97	0
Lower Crescent Creek	114	0

*Acres of moderate and high intensity fire represent stand replacement.


Map # 19 Hydrology
Wickiup Reservoir
MOORE CREEK
Moore Creek
DAVIS CREEK
WICKIUP
WICKIUP
DAVIS LAKE
Davis Lake
Ranger Creek
Odell Creek
DAVIS LAKE
HAMNER BUTTE
MIDDLE LITTLE DESCHUTES RIVER
ODELL CREEK
T. 23 S.
MIDDLE CRESCENT CREEK
LOWER CRESCENT CREEK
CRESCENT CREEK
Legend
Davis Fire Project Area
Watershed (huc5)
Subwatershed (huc6)
Oregon
Deschutes National Forest
N
W
E
S
0 0.5 1 2 3 4 Miles
0 0.5 1 2 3 4 Kilometers
1:185,000
U.S. DEPARTMENT OF AGRIGULTURE
Forest Service
Deschutes National Forest
Crescent Ranger District
Davis Fire Recovery Project EIS
The Forest Service cannot assure the reliability or suitability of this information for a particular purpose. Original data was compiled from various sources and is the most current data available. Spatial information may not meet National Map Accuracy Standards. This information may be updated, corrected, or otherwise modified without notification.

Hydrologic Recovery Analysis (Equivalent Clear-Cut Area)

Past timber management and the Davis Fire have removed overstory vegetation in the eight subwatersheds involved in the Davis Fire Recovery project area (see table 3.9, page 3-76 for past harvest by subwatershed). This has resulted in increased evapotranspiration and water yield. The Equivalent Clear-cut Area model was used to estimate change in evapotranspiration following the Davis Fire. The removal of forest vegetation reduces interception losses of water and the evapotranspiration associated with vegetation. Research by Cheng (1989) and King (1989) found that when a watershed approaches 25 to 30 percent clearcuts (i.e. removal of vegetation); changes in peak flows were documented due to decreased evapotranspiration. Research by Troendle et. al. (1998) found that when a watershed approached 25 percent clearcuts, reduction in the net evapotranspiration resulted in higher seasonal stream flows. Evapotranspiration is the process where virtually all of the water absorbed by plant roots is transpired as vapor back into the atmosphere. Changes in evapotranspiration rates from vegetation removal can cause increases in water yield, peak flow volume, and peak flow duration. This increase in water yield can potentially alter stream channel stability and sediment transport capability.

Roads density is another factor in determining ECA and potential increases in peak flows and sediment transport to stream channels. High road densities have the potential to contribute to elevated stream peak flows. Roadside ditches route water and sediment more efficiently to stream channels. The road densities for subwatersheds that have streams located inside the fire perimeter are shown in the following table.

Table 3.120 Road Density in Subwatersheds that have Streams within Fire Perimeter

Subwatersheds	Subwatershed Number	Total Road Density (Mi/Mi^2)*	Objective Open Road Density	Operational Open Road Density
Odell Creek	170703010202	6.2	3.15	3.35
Moore Creek	170703010203	1.52	.66	.97
Davis Lake	170703010204	5.47	2.35	3.2

*Includes all system roads, open and closed; acres used in calculation includes waterbodies.

ECA is not a good indicator for overall watershed health in this geographic area due to the poor correlation to water yield. However, in the context of this analysis, it can be useful when comparing alternatives using other factors such as soil productivity and access management. In the subwatersheds involved in the Davis Fire Recovery Project, the ECA procedure is less useful in estimating changes in peak flows because of the depths of very porous ash and pumice soils, very low stream density, and the low to moderately sloped topography. Surface creeks and/or expressions of surface runoff are rare to nonexistent (USFS 1999). High infiltration rates of the porous soils account for the very low stream densities (table 3.109). The area in the fire perimeter acts like a sponge, absorbing water from precipitation and releasing it throughout the year in the form of springs or subsurface flow directly to stream channels. There simply is not enough water channeled to draws to create stream channels that have defined banks and annual scour in all but three of the subwatersheds. All of the water in these draws travels downslope, subsurface, until reaching Odell Creek, Ranger Creek, or entering the ground water table around Davis Lake. Based on anecdotal evidence from District employees, during two 100-year events during the 1996-1997 winter, no overland flow was observed in the upland areas. Water was observed running down roads, however.

The Equivalent Clearcut Acre model was chosen as the best model for estimating changes in peak flows. Within the Davis Fire watersheds, because of porous soils, low stream density, and gentle terrain, monitoring in similar watersheds has shown an immeasurable correlation between cumulative openings in the vegetation and peak flows. Further, the fire itself created the elevated coefficients for ECAs in the subwatersheds, therefore subsequent salvage activities in areas where stand replacement occurred would not change that coefficient.

The subwatersheds that have definable stream channels are: Odell Creek, Davis Lake, and Moore Creek (Map #18). The Moore Creek subwatershed has only 60 acres inside the fire perimeter and will not be discussed in

terms of ECA. Odell Creek subwatershed had a pre-fire ECA of 16% and post-fire ECA of 30.5%. Davis Lake subwatershed had a pre-fire ECA 14.7 % and a post-fire 42 %.

Table 3.121 Percent Equivalent Clearcut Acres for Stream-Bearing Watersheds

Subwatershed	Total Acres	% ECA Pre-Fire	% ECA Post-Fire	% change in ECA Acres Post-Fire
Odell Creek	13,830	16	30.5	+14.5
Davis Lake	22,505	14.7	42	+27.3

Water Quality

Temperature

Odell Creek is listed on the ODEQ 2002 303(d) list as "Water Quality Limited" (ODEQ 2002). The entire length of Odell Creek is listed for temperature that exceeds the standard for salmonid rearing (64 ^{0}F) and spawning (55 ^{0} F) (see figure 3.28, Median Channel Temperatures for Odell Creek). Six processes allow heat energy exchange between the stream and its environment: solar radiation, long wave radiation, evaporation, convection, streambed conduction, and groundwater. Although all six influence stream temperature, the principal source of heat energy to the stream is solar radiation (ODEQ 1997). Solar radiation is the amount of direct sunlight that hits the stream surface. The factors that determine the amount of direct sunlight to the stream channel are stream orientation on the landscape and surface area exposure. Streamside shading can block the direct sun to the stream channel, thereby reducing the risk of increases in stream temperature.

1.7 miles of Odell Creek lies within the fire perimeter. The stream channel inside the fire perimeter is classified by Rosgen as a C3 or C4 channel type. In general, this is a depositional area with low gradients, meandering alluvial channel with a well-defined wide floodplain. The area surrounding Odell Creek inside the fire perimeter is very flat as it enters Davis Lake. Between River Mile 1.0 and 1.5 the creek becomes a braided channel. Before the fire the riparian area consisted of grasses, willows, alder and lodgepole pine. This vegetation, mainly the willows, accounted for most of the shade along Odell Creek. Nearly all of the fir species along both Odell and Ranger Creeks were consumed by the fire.

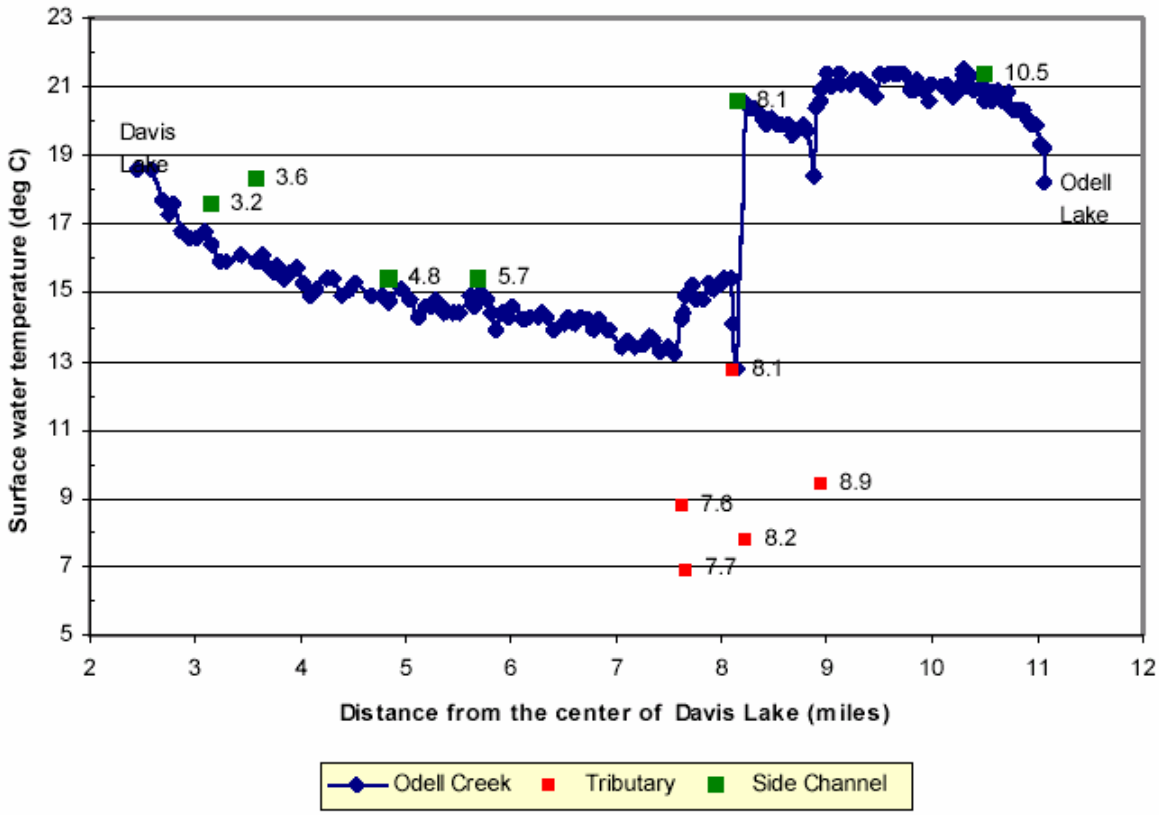


Figure 3.28 Median Channel Temperatures Versus River Mile for Odell Creek along with the Locations of Tributary Inputs (7/25/01). (Deschutes Basin FLIR Report, 2002)

Temperatures were recorded in Ranger Creek during the summer of 1995. Near the headwaters, temperatures were recorded at 4.8º C and as high as 13º C in beaver jam pools. Because Ranger Creek is spring fed it is unlikely any measurable increase in stream temperature will be detected.

There is no data available on water temperature in Moore Creek. Moore Creek had only 60 acres of watershed and a short distance of its length inside the fire perimeter. The lower segment is dry during the summer. No increases in stream temperature are anticipated as a result of the fire.

Crescent Creek is within the same watershed as the Davis Fire and is also 303(d) listed for exceeding the standard for temperature. There is no drainage connecting Crescent Creek or its tributaries from the fire area. There will be no effects from the fire on Crescent Creek's temperature.

Turbidity

Studies indicate that the ability of salmonids to capture food may be impaired at turbidity values in the range of 25 to 70 Nephelometric Turbidity Units (NTU). Growth may be reduced and gill tissues damaged after 5 to 10 days exposure to turbidity of 25 NTU, and some species may be displaced at 50 NTU (McDonald et al. 1991). Turbidity is a result of suspended clay or silt particles in the water column and occurs during storm runoff events. Oregon administration rules states, "No more than 10 percent cumulative increases in natural streams turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity-causing activity." (OAR Chapter 340, Division 41-DEQ).

Activities such as road construction, maintenance and use, and timber harvest can contribute to an increase in stream turbidity. Separating management related turbidity from natural levels would require large amounts of data. There is no turbidity data in the project area and turbidity is not expected to increase over natural levels from the Davis Fire.

Sedimentation

Research in various geographic areas indicates that Forest Service roads are the major contributor to erosion and stream sedimentation. Roads will concentrate flow in roadside ditches that have decreased infiltration rates due to road construction. In some cases these roads are sloped down into the stream as roads approach the stream channel. This area can be used to identify the aquatic influence zone whose health and function might be negatively influenced by these road and ditch features. Roads can add sediment to streams, influence stream migration, reduce floodplain efficiency, affect riparian vegetation, and disrupt travel paths of riparian-dependent species. Road densities within these aquatic influence zones and within perennial stream reaches will assist in identifying where roads might be adversely affecting riparian health and function.

Table 3.122 Percent of Aquatic Influence Zones occupied by Roads within Subwatersheds that have Road/Stream Crossings

Subwatershed	% Area in Roads within AIZs	% Area in Roads within Perennial AIZs
Moore Creek	1%	0.4%
Odell Creek	1%	0.8%

There are two road/stream crossings located on the 4660 road that are outside the fire perimeter. One is over Odell Creek and the other is over Moore Creek. The topography is flat at both crossings limiting the water that is available to the ditch to that which is directly adjacent to the stream channel. Soils in these areas are outwash plains of a thick layer of coarse pumice that exhibit high infiltration rates. As a result, flows rarely occur in roadside ditches. The roads in this area are closed during winter months due to heavy snow. There is no anticipated increase in sediments from roads from pre-fire conditions to post fire conditions.

In addition to sediment contributed from roads, there is the potential for post-fire storm flow to contribute ash and erode soil along Odell and Ranger Creeks. However, due to the highly porous soils, flat topography, woody material on the floodplain, and riparian regrowth, this should be limited to the area directly adjacent to the stream channel.

Potential sedimentation from the upslope areas, Hamner Butte and Davis Mountain, can be analyzed by looking at the burn severity in the fire perimeter, soils in the upland areas, and drainage density. Burn severity can indicate the amount of soils that exhibit hydrophobicity. Hydrophobic soils repel water that increases as it moves down slope causing erosion and the possible sedimentation that degrades water quality. Low burn severity would indicate that the soils exhibit natural infiltration rates that unburned areas do. Approximately 20,752 acres were classified as low severity and 508 acres classified as moderate severity (USFS 2003). Additionally, the Deschutes Soils Resource Inventory (SRI) identifies mapping unit 98 as the majority soil type found on Hamner Butte and Davis Mountain. This landtype consist of a thick layer of pumice and volcanic ash 40 to 80 inches deep. The infiltration rate is high even when thoroughly wetted. SRI mapping unit 98 has low erosion hazard rating.

Stream density on both Hamner Butte and Davis Mountain is nonexistent. As mentioned earlier this is due to the high infiltration rate and depth of the pumice soil. Water simply moves downslope subsurface until it encounters the water table adjacent to Odell Creek or Davis Lake. It is unlikely that sediments from the upslope areas on Hamner Butte or Davis Mountain will reach Davis Lake or Odell and Ranger Creeks.

There is no evidence of sediment problems in Odell Creek associated with past management practices. Forest Service level II stream surveys in 1998 indicate that the dominant substrate in Odell Creek in reach 3 and reach 2

are gravels and cobbles, and in reach 1 the dominant substrate is gravels. All three streams reaches' substrate exhibit what would be expected in a natural undisturbed stream.

Chemical Contaminants/Nutrients

Herbicides Dicamba is an herbicide used at site-specific locations alongside Forest Service Road 46 (Cascade Lakes Highway) to control noxious weeds. This herbicide is used for spot applications over a ½ acre area at a concentration of 17 ounces within that ½ acre area. The use of dicamba has been approved under a 1998 Noxious Weed Environmental Assessment that included mitigation measures for its use, such as no application of chemicals within 20 yards of perennial streams or live intermittent streams for ground application.

Fire Retardant From airtanker records, it was determined that 12 drops of retardant during fire suppression activities on the Davis Fire occurred within or near the fire perimeter. Refer to the Soils section for an in-depth discussion on the possibility of contamination of the soil and leaching into Odell Creek. Two of the 12 retardant drops may have occurred across stream drainages (one across Odell Creek, and one across the ephemeral drainage located to the southeast of Odell Creek). There is no on-the-ground evidence (e.g. red dye on vegetation or observed fish kills) that could confirm this. The majority of retardant was applied to upland locations far enough from channels where a very low percentage could contribute to stream concentrations as a result of overland flow mechanisms. The effects of retardant chemicals on water resources depends on the extent of heat-induced transformations from the fire, soil characteristics, and leaching pathways (see pages 3-71 to 3-73 for a discussion of retardant applications and transformations). The two drops that reportedly occurred across stream drainages were close enough to contribute surface or subsurface flows to these drainages if a rainfall event were to occur. Rainfall occurring during an August event measured 0.32 inches and was not sufficient to create surface flows within the intermittent drainage, especially considering the infiltration rates of the surface soils, low soil moisture during that time of year, and nearly level slopes. Runoff into the perennial reach of Odell Creek is also likely to have been very low from this rainfall event for these same reasons, in addition to the relatively controlled flow of this reach from spring-fed and lake outlet sources that limits flows above bankfull outside of spring peak flows.

Environmental Consequences

Summary of Effects

Alternative A

Alternative A (No Action) may pose a risk to water quality resources even though no harvest would occur. Conditions and hydrologic function would continue as described in the Existing Condition section. Shade and woody material recruitment along Odell and Ranger Creeks would continue to recover at natural rates. Hydrologic recovery from revegetation of the upland areas would continue at natural rates, but slower than Alternatives B, C and E. Alternative D treats the least amount of the upland areas through harvesting and replanting and is more closely comparable to Alternative A in terms of hydrologic recovery. Road density would not be reduce and activity-related road maintenance would not occur. Watershed improvement projects such as fuel reductions that would reduce the fuels in the Davis Fire area would not be implemented. High fuel levels that resulted from the Davis fire would continue to pose the greatest risk to aquatic resources, from increased water yields and sedimentation, in the event of a re-burn.

Alternatives B, C, D, and E

The proposed salvage is part of the larger Davis Fire Restoration Project being considered in a larger context of fire restoration. Proposed and common to all action alternatives is planting of riparian vegetation, bitterbrush, and various levels of conifer regeneration. Burned Area Emergency Response (BAER) projects such as monitoring for slope stabilization and noxious weed invasion are ongoing within the fire perimeter, while several

other recreation-related projects and projects to improve the hydrologic function of Odell Creek are in various stages of development and planning.

The conditions that reduce the likelihood that proposed activities are capable of exacerbating watershed conditions include:

- The Davis Fire occurred in the "bottom" of the subwatersheds which is considered as a relatively closed system at Davis Lake (figure 1).
- Proposed activities are in soils that are well-drained (i.e. pumiceous).
- Best Management Practices will be employed (see mitigations section).
- There are no proposed salvage harvest activities within Riparian Reserves or Riparian Habitat Conservation Areas.
- All planned activities have been determined to meet Aquatic Conservation Strategy and Riparian Management Objectives.

Based on the amount of ground-disturbance in each alternative, Alternative B has the highest potential to create sediment or turbidity; Alternative C has the second highest; Alternative D is the second least ground-disturbing; and Alternative D has the lowest potential to produce sediment to the streams. When compared to the expected temporary increases in sediment yield within the Davis Fire area caused by loss of vegetative cover and the amount of soil exposed by the fire, the predicted increases in sediment delivery from any action alternative would be negligible.

Water Quality

Sediment

Alternative A

Under the No Action Alternative, soil erosion and water yield may see a slight increase because of vegetation removal from the Davis Fire. Davis Lake, Wickiup Reservoir, Odell Creek, and Ranger Creek are the surface waterbodies that could receive sediment eroded from adjacent riparian and upland locations. Estimates for post-fire sediment rates show an increase of 900% to 1,050% but actual amounts would be very low and processed by the stream volume as bedload material (see Sediment Yield, page 3-67 of Soils section). Estimated first-year sediment yields are shown in table 3.6, page 3-68. Sediment delivery will decrease as vegetation regrows.

Coniferous vegetation cover that intercepts and reduces overland flow and sediments, especially in high fire intensity areas, would not recover as rapidly as in the action alternatives. Increases in water yield would not return to pre-fire conditions as rapidly as the action alternatives. Fuel treatments that would reduce the risk of heavy accumulation of fuels would not take place.

The discussion of Riparian Reserves in the Fisheries section describes the benefits of no-cut buffers around waterbodies in the project area. As fire-killed trees are windthrown to the ground, the coarse wood along with re-sprouting vegetation act as sediment traps to intercept rainfall before it hits bare mineral soil and reducing the energy of overland flows generating during storm events.

Alternative B

Alternative B proposes to salvage harvest a total of 6,355 acres (30% of the burned area). This alternative proposes to harvest 3,785 acres (17% of the burned area) using a ground based logging system on slopes that are less than 20 %, 800 acres (4 %of burned area) using a skyline system on slopes that are greater than 20 %, and 1,770 acres (8 % of the burned area) helicopter logging system that are also greater than 20 %. This alternative will treat 1,450 acres of fuels (7 % of the burned area), and reforest 8,400 acres (38 % of the burned area). This alternative requires 11 miles of temporary roads to reach the interior portions of units. Ground-disturbing

actions include: salvage of dead trees, hazard tree removal, planting of trees and shrubs, road maintenance, temporary road construction, fuel treatments and subsoiling.

All proposed units in each of the action alternatives and temporary road construction have been assessed for existing and potential sediment sources and slope stability concerns. There are no areas identified as areas of concern for stability. There is no harvest or temporary road construction inside riparian reserves. Three units (15, 20, and 120) are located within the 480 foot sediment delivery zone, as analyzed in the Soils Report (Sussmann 2004). These units will utilize a helicopter logging system, which would incur the lowest amount of soil disturbance as compared to skyline or ground logging systems and logging is not allowed within the 300' Riparian Reserve around the lake's perimeter. Sedimentation to Davis Lake from these units is unlikely to occur because the topography of the area is relatively flat (averaging less than 2%), erosion control mitigation will be applied, and no commercial harvest will take place within Riparian Reserves. Leaving the strip of undisturbed trees in the riparian reserve along Davis Lake will provide dead woody material when dead trees begin to fall over. This down wood will intercept and inhibit the delivery of mobilized sediment to the water body. Down wood will also be effective in retaining topsoil, which will aid the quicker recovery of riparian vegetation. These measures will eliminate or reduce sediments entering waterbodies, so there will be no degradation of water quality.

Temporary road construction is estimated to be 11 miles, the highest of the alternatives, due to the amount of ground-based logging systems (3,785 acres). All temporary roads will be constructed according to the mitigation measures and BMPs described in the appendix. Most roads will use existing skid trails used for harvest and yarding operations and would involve some level of improvement, primarily widening with a dozer blade. The Beschta report states that "building roads in the burned areas should be prohibited." It further states that roads are associated with a variety of negative effects on aquatic resources, including disruption of basin hydrology and increased chronic and acute sedimentation; that under no circumstances should new roads be introduced into sensitive areas, including roadless or riparian areas. As mentioned earlier, temporary roads will be located on ridge tops or in flat areas, will avoid riparian reserves, and these roads will be decommissioned after the salvage and planting activities are completed (subsoiled where possible to return hydrologic function to the areas). Roads will not have an effect on basin hydrology or produce chronic and acute sedimentation to aquatic resources.

There is only one stream crossing (Forest Road 4660 crossing Odell Creek) which may be used for haul. To reduce the potential for sediment to enter Odell Creek at the stream crossing, the following conditions will apply: If hauling occurs during the rainy season, (April to July) filter cloth fencing is required in adjacent roadside ditches, 25 feet from the stream channel. If log hauling occurs in the dry season (July to October) dust (fine particles) will not increase turbidity levels above 10% over natural levels set by the DEQ.

Reforestation activities have the potential to increase sediment from scalping the area (approximately 1 square foot) around where the seedling is to be planted. This is not anticipated to reach the stream channel since the material would most likely stay directly adjacent to the area being scalped. Reforestation would occur in all salvage units which would re-establish pre-fire erosion rates more rapidly that the No Action Alternative. In addition, upland harvest and fuel treatment would reduce the risk of catastrophic fires that could increase erosion and sediments.

Along with very flat topography, high infiltration rates, no harvest inside riparian reserves, and mitigation measures applied to logging and log hauling, expected sedimentation to streams or lakes from Alternative B will be negligible when compared to increases in sedimentation resulting from the fire.

Alternative C

Alternative C proposes to salvage harvest total 6,355 acres (30% of the burned area). This alternative proposes to harvest 3,130 acres (14% of the burned area) using a ground-based logging system on slopes that are less than 20 %, 190 acres (1 %of burned area) using a skyline system on slopes that are greater than 20 %, and 3,035 acres (14 % of the burned area) helicopter logging system that are also on slopes greater than 20 %. This alternative will treat 1,450 acres of fuels (7 % of the burned area), and reforest 8,400 acres (38 % of the burned

area). This alternative requires 9 miles of temporary roads second highest of the alternatives due to the second highest acreages scheduled for ground-based logging.

Effects on sediment and turbidity levels from Alternative C are similar to those discussed for Alternative B, because the proposed salvage is in the same areas. More areas are identified for skyline or helicopter logging systems, though which cause less soil disturbance than ground-based logging systems. The difference in logging systems will not change expected sediment to waterbodies, because of the distance from these units to Odell Creek or Davis Lake. As with Alternative B, Best Management Practices will apply.

Alternative D

Alternative D proposes to salvage harvest a total of 1,045 acres (4.8 % of the burned area). This alternative proposes to harvest 850 acres (4 % of the burned area) using a ground-based logging system on slopes that are less than 20 %, 195 acres (1 % of burned area) using a skyline system on slopes that are greater than 20 %. No helicopter logging would occur in this alternative. This alternative will treat 1,750 acres of fuels (8 % of the burned area), and reforest 2,030 acres, highest of the alternatives (9% of the burned area). This alternative requires 3 miles of temporary roads second lowest of the alternatives. As a result of the small acreage being harvested, this alternative is the second least ground disturbing of the alternatives, (1,045 acres).

Alternative E

Alternative E proposes to salvage harvest a total of 3,290 acres (14 % of the burned area). This alternative proposes to harvest 3,290 acres (14 % of the burned area) using a helicopter logging system on all slopes. This alternative will treat 1,450 acres of fuels (7 % of the burned area), and reforest 4,070 acres (9% of the burned area). This alternative does not require construction of temporary roads. Due to helicopter logging system and no temporary road construction, Alternative E is the least ground disturbing alternative. As a result of the least amount of ground disturbance, this alternative has the lowest potential to produce sediment to the stream channels.

Cumulative Effects, All Alternatives

As mentioned earlier, there is no evidence of problems in Odell Creek associated with past management practices on sediment production. Forest Service level II stream surveys in 1998 indicate that the dominant substrate in Odell Creek in reach 3 and reach 2 are gravels and cobbles, and in reach 1 the dominant substrate is gravels. All three streams reaches substrate exhibit what would be expected in a natural undisturbed stream. Since mitigation measures have been applied to the only stream crossing in the project area, erosion or sedimentation will not adversely affect the water quality of Odell Creek.

Fire suppression dozer lines, hand lines, safety zones, roads and drop points were rehabilitated by pulling back material that had been pushed out by a dozer and placing woody material on disturbed areas. This will reduce the potential for erosion in these disturbed sites. The table on the following page summarizes the fire suppression activities that took place within the Davis Fire area in the summer and fall of 2003.

All action alternatives would accelerate conifer establishment to some degree (most with Alt. B and C, least with Alt. D) thus lowering sediment delivery potential in the long term (5 years or more). A Road Analysis has been completed and the road management recommendations include closing a net of 33 miles of open roads within fire area and decommissioning 5.4 miles of road. These actions are not included in this EIS, but it is likely they will be implemented in the future.

Table 3.123 Summary of Fire Suppression Activities on Davis Fire, 2003

Rehabilitation Needs	Miles	Number	Est. Acres	Completed
Grading/Shaping Roads	78	--	--	78
Surface Drainage	49.5	--	--	49.5
Dozer Line	14.4	--	--	14.4
Hand Line	0.8	--	--	0.8
Drop Points	--	30	7.5	30
Staging Areas	--	1	.5	1
Safety Zones	--	4	2	4
Stand Pipes	--	2	0.5	2
Turnarounds/Parking	--	10	4	10
Culvert Replacement	--	1	--	1

Stream Temperature

Alternative A

Direct, Indirect and Cumulative

There would be no direct affect from Alternative A. No actions will take place that improve or degrade water quality. Proposed riparian planting along Odell Creek would not occur, as a result, stream temperatures would not recover to pre-fire levels as rapidly as in the action alternatives.

Grasses and willow will benefit from the fire and will show vigorous growth in the first year. Odell Creek and Ranger Creek may experience a slight increase in stream temperature within the fire perimeter in the short term (0-5 years). But as vegetation becomes reestablished, the shade will be increased, and the risk of elevated water temperatures from exposed stream surface will be reduced. The largest influence on the temperature of Davis Lake is the high surface area to volume ratio; therefore, any increases in the temperature of tributaries are not expected to measurably affect the temperatures in Davis Lake.

Alternatives B, C, D, and E

Direct and Indirect

Salvage harvest has the potential to directly affect water temperature by removing the shade component along stream channels. No harvest is planned within the riparian reserves along stream channels or around Davis Lake under any action alternative. Under all action alternatives, supplemental riparian planting will be completed on 1.5 miles of Odell Creek to help facilitate re-growth of vegetation and should recover shade more quickly than the no action alternative.

No commercial salvage will occur within the 300 foot riparian reserves on Odell or Ranger Creeks. There is no anticipated increase in stream temperature from salvage under any of the action alternatives because no trees, live or dead, would be removed that provide shade. Small diameter fuels reduction activities would not affect stream temperature.

Cumulative

There might be a slight increase in stream temperatures from the vegetation removal from the fire in the short term. Instream work on Odell Creek (construction of logjam structures) will make the stream deeper and should provide additional shading on the stream. Recruitment from burned lodgepole adjacent to the stream will also provide more shade as the trees fall.

Stream temperature is expected to rise slightly along Odell Creek in the short term (0-5 yrs) inside the fire perimeter due to the loss of riparian vegetation. Since there is no harvest inside the riparian reserves, salvage operation in the action alternative will have no cumulative effect on stream temperatures. Riparian Planting will re-vegetate the riparian area more rapidly which will begin to contribute shade and intercept solar radiation. The log placement project described earlier should contribute shade to the surface of Odell Lake and trees burned in the Davis Fire will also provide shade in the future as they fall into the creek.

Chemical Contaminants/Nutrients

Direct and Indirect Effects, All Alternatives

There would be no direct or indirect effects from chemical contaminants on the water quality in the project area.

Cumulative Effects All Alternatives

Treatment of noxious weeds with the herbicide Dicamba will continue along Highway 46. It is not expected to reach any water bodies as the herbicide is applied for spot treatments, and is sufficiently far enough away from any water body. There are no stream crossings along the FS 46 and therefore no delivery mechanisms to carry the herbicide directly to Odell Creek or Davis Lake. The herbicide could leach down through the soil and enter the ground water table and then be transported to the stream or lake, however by that time concentrations would not likely be great enough to pose a risk to aquatic organisms.

Hydrologic Recovery

Alternative A

Hydrologic recovery as mentioned in the current conditions section as measured by ECA refers to a procedure devised to estimate the ability of drainage to accept an increase in water yield from the removal of vegetation, or a "rain-on-snow" event without significant impacts to the stream channels. As a result of total tree mortality from the Davis Fire there will be an increase in water yield inside the Davis fire perimeter from decreases in evapotranspiration or the less likely rain-on-snow event. This increase will be released in the lower reaches of Odell Creek or gradually into the ground water surrounding Davis Lake. Increases in water yield will not be significant enough to alter the physical characteristic of either Ranger or Odell Creeks inside the fire perimeter. This increase in water yield will be mostly subsurface and occur during spring melting.

Vegetation would be reestablished naturally; as a result hydrologic recovery would be slower than the action alternatives. Stand replacement analysis indicates that stands will be re-established more rapidly if replanted. In 40 years tree diameters would be 2-6 inches dbh by natural revegetation (USDA Forest Service 1993). Full hydrologic recovery is expected at 60 years.

Alternatives B, C, D, and E

The Davis fire has reduced the amount of evapotranspiration making more water available for soil water, aquifer recharge, and streamflow. Although the Davis fire will likely increase streamflow inside the fire perimeter in

Odell and Ranger Creeks from a decrease in evapotranspiration, salvage of dead trees will have no effect on increases in streamflow or stream channel stability. Virtually all the vegetation that transpires water vapor back into the atmosphere was consumed by the fire. Although some precipitation would adhere to trees and return to the atmosphere, harvest would not measurably reduce interception or evaporation.

Alternatives B and C would harvest and replant more acres than Alternatives D or E, as a result, hydrologic recovery would recover more rapidly (40 yrs) in Alternative B and C than in Alternatives D or E. Tree diameters are expected to be 7-10 dbh at 40 years if reforested after salvage operation are completed (USDA Forest Service, 1993). The harvesting and replanting areas with trees will reduce increases in water yield back to natural levels more rapidly than Alternative A.

Cumulative Effects Alternatives B, C, D, and E

Cumulative effects on water quality, and increases on water yield and peak flows, from past and future foreseeable actions are not anticipated to adversely affect stream channel stability or water quality of Odell Creek, Ranger Creeks, Crescent Creek or Davis Lake.

The Crescent Lake Wildland-Urban Interface Fuels Reduction Project is a proposed thinning project that will occur in Middle Crescent Creek and Odell Creek subwatersheds. Currently the post fire ECA values in the Middle Crescent and Odell Creek subwatersheds are 23.97 and 30.5 respectively. Both subwatershed values included the proposed action in the Crescent Lake Wildland-Urban Interface Fuels Reduction project. Surveys indicate that no immediate connection can be drawn between those watersheds with levels over 20 percent and damage to stream channels (USFS 2001). This may indicate that highly permeable soils, relatively gentle slopes, and other characteristics of these watersheds make them more resistant to the effects from vegetation and ground manipulations.

As mentioned in the Existing Conditions section, a very small area of the fire occurred in Crescent Creek and Middle Crescent Creek subwatersheds (see table 3.108). The portion of the fire within these subwatersheds is located at the top of Hamner Butte, where drainage densities are nonexistent (map #19 and table 3.109). Salvage harvest in these subwatersheds will not have a cumulative effect on water quality in Crescent Creek.

The Five Buttes Interface project (formerly Seven Buttes Return) is located near the Davis Fire area and is a foreseeable action in the near future, this project proposes to include thinning, large tree culturing, and salvage on approximately 7,100 acres. Typical of similar projects within the area, this one would be characterized as a conservative attempt to lower stand susceptibility to a large scale disturbance while maintaining sufficient crown closure for spotted owl habitat. In consideration of cumulative impacts, this prescription would not appreciably change the overall hydrologic recovery, or water quality indicators for the respective watersheds analyzed for the Davis Fire Recovery Project."

Riparian Area Vegetative Condition/ Large Woody Material

Alternative A

If Alternative A is selected, riparian vegetation would not recover as rapidly as in the action alternatives because no riparian planting would be done. In addition the accumulation of fuels from fire killed trees adjacent to riparian reserves pose a high risk of re-burn that threatens the revegetation of the riparian areas.

Alternatives B, C, D, and E

Forest objective levels for current amounts of large woody material will be maintained and the additional harvest proposed by this project would not reduce the potential for future development and recruitment of woody material within riparian reserves. No harvest would occur within riparian reserves under any of the alternatives.

All action alternatives include riparian planting along 1.5 miles of Odell Creek. A Riparian Reserve Area no-cut buffer within 300 feet of Odell, Ranger Creeks and Davis Lake will maintain current water temperatures, provide for a constant high level of fine organic material input, and maintain existing stream stability.

Aquatic Conservation Strategy Objectives

All proposed alternatives are consistent with the following Aquatic Conservation Strategy objectives outlined in the Northwest Forest Plan (USDA/USDI 1994). These objectives are met through the implementation of "Best Management Practices" (USDA 1988) and standards and guidelines outlined in the Deschutes National Forest Land and Resource Management Plan (USFS 1990) and the Northwest Forest Plan. The 2004 Record of Decision to Clarify Provisions Relating to the Aquatic Conservation Strategy is now in effect. The alternatives are designed to maintain or restore the fifth field watershed over the long term. The following summarizes and provides rationale for maintaining ACS Objectives.

1. *Maintain and restore the distribution, diversity, and complexity of watersheds and landscape scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adopted.*

Alternative A

The no action alternative would allow the project area to recover without further vegetative management activities. This alternative allows for watershed and landscape scale processes to recover under natural conditions and rates and would maintain the post-fire distribution of vegetative conditions across the affected watersheds. High fire intensity within the lodgepole plant association group (PAG) in the Davis Lake basin along Odell and Ranger Creeks and the Mixed Conifer Dry and Ponderosa Pine PAGs on Davis Mountain and Hamner Butte has created large areas of homogenous stand conditions at a landscape scale. The extent of these areas covers approximately 30% of the length of Odell Creek and the entire length of Ranger Creek.

Areas of Stand Replacement mortality (>80%) would recover as similar age class vegetative stands with some variety of understory and tree species provided by variations in natural regeneration rates and moisture regimes. The return of conifer species within these areas capable of providing shade to stream channels would be the slowest of the alternatives. The distribution and level of coarse woody debris fuel loads would also be somewhat homogenous throughout these areas as a result of non-intervention for salvage purposes.

Action Alternatives

All action alternatives would maintain the recommended riparian reserve widths outlined in the Northwest Forest Plan. Reforestation of proposed upland salvage areas would likely more rapidly restore the diversity and complexity of the uplands within the fire perimeter by providing an immediate conifer component important for long term objectives to these areas. Proposed salvage would remove dead trees in excess of wildlife and soil productivity needs and treat fuel loads on approximately 20 to 30% of the Odell Creek and Davis Lake subwatersheds. Planting of lodgepole pine within Key Elk areas of the Davis Lake basin and along Odell Creek, after two years monitoring for regeneration success, would also jumpstart the return of conifers capable of providing shade and cover for aquatic species.

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

All alternatives maintain existing riparian connections between watersheds. Post-fire conditions have created somewhat homogenous vegetative conditions within riparian reserves. Their function as connectivity corridors and shade for fish habitat has been interrupted in the short-term under reduced vegetative cover

conditions. The return of riparian shrub and herbaceous species, and the accumulation of down woody debris should increase their function levels as connectivity corridors over time by providing the habitat required for connectivity within watersheds.

The action alternatives propose to harvest dead trees located on uplands in Stand Replacement mortality conditions that do not provide valuable connectivity conditions for many riparian dependent species under post-fire conditions. Their treatment would still leave snags and down wood at levels capable of providing habitat for cavity nesters and some ground species. Many acres of untreated stands would continue to provide these features at significantly higher levels. Treated activity acres would be planted with conifers which will provide greater ground and hiding cover within these stands and help develop functioning connectivity corridors between subwatersheds in a shorter time frame than under natural recovery conditions.

Spatial and temporal connectivity of the post-fire environment along stream drainages will be maintained through the implementation of the Forest Plan riparian reserve widths (USDA 1994). All fish bearing streams will have no-harvest buffers of two standard tree height or 300 feet. Non-fish bearing streams and ephemeral streams will have one standard tree height or 150 feet no-harvest buffer placed on either side of the stream. These areas allow for connectivity between riparian areas and upland areas. In addition, none of the alternatives proposes to build roads across any stream channels.

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

Physical integrity of the aquatic system is anticipated to be maintained and preserved by adhering to the recommended riparian reserve widths outlined in the Odell Watershed Analysis and by using Best Management Practices (BMPs) (USDA 1988). Specific BMPs are T-2 (harvest unit design); T-7 (Streamside Management Unit Designation); T-8 (Stream Course Protection). These practices maintain the physical integrity of the aquatic system by designating prescriptions (i.e., maintenance of root strength, shade canopy, and large woody material).

The action alternatives would not restore the physical integrity of the aquatic system but are likely to maintain current conditions. Odell and Ranger Creeks are both spring fed systems with small bedloads and little variation in peak flows. Although proposed salvage would physically disturb a portion of subwatershed upland areas it is unlikely that this would occur at levels measurably above the risks already present under low cover conditions.

No salvage treatments are proposed within riparian reserves. These alternatives would maintain the post-fire levels of fine and coarse woody material within the reserve corridors that could replace material consumed during the fire within the stream channel and on adjacent stream banks. This material is integral for developing and maintaining the physical structure of the aquatic system by contributing to the development of pools and slow water depositional areas that retain sediment. At the watershed and landscape scale, implementing the action alternatives would maintain the current physical integrity of Odell Creek and the Davis Lake basin.

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

The primary concerns to water quality in the project area are increases in water temperature in Odell Creek and Davis Lake. Water quality parameters regulated by the State of Oregon under the Clean Water Act include temperature, turbidity, and total dissolved solids in streams and temperature, pH and chlorophyll a in lakes. Portions of Odell Creek and Davis Lake are on the state 303(d) list for exceeding water temperature standards for bull trout rearing or red band salmonid water bodies. The reduction of shade is the primary action of concern related to increases in water temperature while increased erosion and sedimentation are the

most likely to affect turbidity and total dissolved solids. The transport of nutrients and/or retardant residues to the streams as a result of sediment delivery can also affect the pH and chlorophyll a content of a lake water resource.

Alternative A

Post-fire cover conditions as a result of the Davis Fire would continue to have the greatest affect on water quality. Although the primary factor influencing elevated stream temperatures is the outflow of warm water from Odell Lake during the summer months, temperatures in the lower reach of Odell Creek are susceptible to increases over the next few years as a result of the loss of shade provided by conifers within the riparian buffer. Minimal shade would be provided by remaining standing snags until natural regeneration of lodgepole conifers returns live trees to this area. Streamside re-sprouting of willow and alder will continue along this reach and begin to provide shade in some areas after the next growing season. Elevated stream temperatures during the summer months would decrease at the slowest rate under this alternative. Ranger Creek is entirely spring fed and is unlikely to show measurable increases in stream temperature despite the loss of shade provided by conifers along this reach.

Turbidity is a result of suspended clay or silt particles in the water column and occurs during storm runoff events. The primary condition affecting the turbidity of Odell Creek under this alternative is the exposure of mineral soil from the combustion of organic cover during the fire event. Although mineral soil has been exposed within the riparian buffers, the minimal slopes, high infiltration rates, surface roughness provided by down woody material, and immediate vegetative re-sprouting combine to minimize the risk of overland flows and contributed sediment to the creek. Changes in turbidity are expected to be minimal under all alternatives, with a decreasing risk over time.

Action Alternatives

Water temperatures of Odell Creek and Davis Lake would only slightly be impacted by the action alternatives in the next few years. Small diameter non-commercial fuels treatments surrounding developed sites at Davis lake are not expected to have a measurable effect on stream temperature. Portions of two fuels treatment units are within the riparian buffer in which a few standing snags that currently provide some solar deflection would be removed. Approximately 1.5 miles of Odell Creek would be replanted with lodgepole seedlings to provide an immediate return of conifers capable of providing shade to the stream possibly sooner than under the no action alternative. These seedlings would not be expected to provide significant amounts of shade capable of minimizing temperature increases in the lower reaches of Odell Creek for a number of years. The addition of planted conifer seedlings may also allow for an increased accumulation of snow in these areas as well as a delay in snowmelt that could help minimize water temperature increases sooner when compared to the no action alternative.

Implementation of the action alternatives would include no salvage treatments within RHCA/RR buffers in order to reduce disturbance within sediment delivery zones identified during the analysis. Oregon administration rules states, “No more than 10 percent cumulative increases in natural streams turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity” (OAR Chapter 340, Division 41-DEQ). The action alternatives also propose to close road 4660/600 and associated dispersed camping spurs along Odell Creek which would reduce vehicular disturbance within the buffers and reduce hydrologic connectivity of the road system with Odell Creek.

Other activities such as road construction, use and maintenance, and ground disturbance from timber harvest can contribute to an increase in stream turbidity. Separating management related turbidity from natural levels would require large amounts of data. As discussed under the no action alternative, the lack of slope, minimal drainage features and high infiltration rates would minimize overland flows capable of detaching sediment and carrying it directly into stream channels. The project would also follow BMPs to maintain water quality that maintain detrimental soil disturbance at or below 20% within an activity area, obliterate temporary roads after their intended use, and restrict logging activities to times and locations appropriate for site conditions. Although there is no turbidity data in the project area, increases in turbidity levels over natural levels are not expected to be measurable as a result of the action alternatives.

Implementing the action alternatives would maintain the current water quality in the Odell Creek and Davis Lake subwatersheds and maintain the current water quality of the Davis Lake basin in the long term. Biological, physical and chemical integrity of water quality will be maintained using BMPs and by applying riparian reserve widths. Implementation of full riparian reserve widths on all stream channels and wetlands will also maintain temperature, chemistry, and suspended loads at current levels.

Alternative B, C, and E are designed to restore the area to within its historical fire regime parameters through fuel reduction and prescribed fire at year 30-40. This could reduce the extent and intensity of future large-scale wildfire within the subwatersheds that have an inherent risk to water quality. The planting of conifer seedlings within salvage units would increase stand recovery rates, increasing surface cover and reducing overland erosion that can reduce water quality within a subwatershed.

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

Alternative A

Low cover, post-fire conditions have been identified in the EIS analysis as the largest potential source of sediment within these subwatersheds. The sediment delivery zone of overland flows to stream channels under all but the most extreme runoff conditions includes area within approximately 480 feet from a channel edge. Although the sediment regime along Odell Creek has been altered to some degree as a result of the loss of cover, the amounts moved and delivered to stream channels are expected to be relatively low due to the low slopes, minimal hydrologic connectivity of roads, surface roughness provided by down woody debris, and high infiltration rates of the soils present. Delivery rates during storm events would steadily decrease as vegetative re-growth provided cover to reduce raindrop impacts.

Re-growth that has occurred since the fire in upland locations outside the riparian buffers would not be disturbed by mechanized activities under this alternative. The return of fine woody material from tree branches and coarse woody material from tree boles to the soil surface would be slightly slower than within treatment areas proposed under the Action Alternatives.

Action Alternatives

All action alternatives will maintain the sediment regime under which these systems evolved. Alternatives would provide no treatment zones within 320 feet of perennial stream reaches that would minimize additional introduction of sediments over current post-fire risk levels. The input of sediments to spring-fed and weir controlled streams is typically from hydrologic connectivity with roads. No additional roads with hydrologic connectivity would be constructed under the action alternatives. Road 4660/600 and associated spurs to dispersed campsites would be closed and obliterated under implementation of these alternatives.

The action alternative would create skid trails, landings and temporary roads capable of contributing sediment and generating concentrated flows within these subwatersheds. All proposed salvage activity areas are at least a half a mile from stream channels and would have difficulty contributing sediment into the aquatic system unless there was direct hydrologic connectivity provided by the road system. Although post-fire re-growth of ground vegetation within salvage units would be crushed and/or uprooted to varying degrees by mechanized harvest and yarding activities, vegetation is also likely to return at reasonable rates over time to provide cover capable of reducing raindrop impacts. Harvest and fuels treatment activities would also generate organic input directly to the soil surface that would provide surface roughness capable of reducing overland flow energies in these areas.

Proposed activity units would be planted with conifer seedlings following harvest and fuels treatments, increasing stand recovery rates and associated surface cover. The alternatives would follow BMPs intended to implement riparian buffers, maintain soil compaction at or below 20%, locate temporary roads on existing skid trails and subsoil them where possible, and restrict logging activities to times and locations appropriate for site conditions. Treatment areas would have minimal net increase in sediment production and delivery as a result

of the proposed salvage activities, especially when compared to immediate, post-fire conditions. Although localized changes to the sediment regime may occur along Odell Creek, the post-fire regime throughout the Davis Lake basin would be maintained by the project proposal and likely steadily decreased toward pre-fire levels over the next five to ten years.

6. *Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitat and to retain patterns of sediment, nutrient, and wood routing.*

Alternative A

Changes in storm flows that could occur as a result of the fire are not likely to alter patterns of sediment, nutrient, and wood routing in the Odell Creek system. Base flows would be maintained and slowly returned to pre-fire levels as vegetative cover returned. Wood recruitment in the next twenty years is likely to be higher under all alternatives when compared to pre-fire conditions as standing dead trees begin to fall into the stream channels. A void of wood recruitment is likely to occur after fire-killed snags have all fallen and before natural regeneration of lodgepole is large enough to provide this component.

The No Action alternative would have little measurable affect on the magnitude, duration, and spatial distribution of peak, high, and low stream flows occurring after the Davis Fire. The vast majority of stream flow volume within Odell Creek comes from outside the fire perimeter in the form of tributary springs and outflows from Odell Lake. No defined drainages contribute stream flows to Odell Creek from uplands within the fire perimeter. The loss of forest vegetation within the fire perimeter will reduce the evapotranspiration losses from this component and is likely to increase the amount of "unused" water capable of percolating into the stream channel through the hyper-reach zone. The potential for overland flow contributions to stream flows is also slightly increased as a result of increased soil moistures during the summer months when thunderstorm events are most likely to occur.

Action Alternatives

None of the action alternatives are expected to negatively affect base flow conditions. The loss of forest vegetation would decrease evapotranspiration losses within the subwatershed and likely produce increased groundwater contributions to the Davis Lake system and may increase storm flow contributions from summer thunderstorm events. Overall, the action alternatives would have no measurable effect on streamflow because no live trees would be removed. Recovery of evapotranspiration processes and precipitation interception in the long-term would be more rapid under the action alternatives when compared to the no action alternative. These alternatives would not affect instream flows to an extent that would inhibit riparian, aquatic and wetland habitats.

The timing, magnitude, duration, and spatial distribution of flows contributed by storm events and associated overland runoff from areas within the fire perimeter could be minimally increased from post-fire conditions as a result of ground disturbing activities until re-vegetation occurs. Increased overland flows are unlikely to contribute to instream flows since all proposed salvage activity units are located at least a half a mile from Odell Creek and no defined drainages contribute storm or snow melt flows to the stream from uplands within the fire perimeter on which proposed salvage activities are located. In-stream flows would be sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing needed for aquatic health until a live forest component returns. Wood routing would be maintained by the presence of fire-killed snags within a single tree height of the stream.

All wet areas less than 1/4 acre and stream courses will be protected through the implementation of riparian reserves. The wetland areas adjacent to the high water line of Davis Lake are also not likely to be affected by the action alternatives due to the implementation of buffers along units 15, 20 and 120.

The action alternatives are expected to maintain post-fire patterns of sediment, nutrient, and wood routing to the aquatic system. A change in sediment and nutrient amounts delivered to the streams is likely to be immeasurable when compared to the potential amounts delivered under current, post-fire cover conditions (see table 3.6, for predicted sediment yield). All material removed from salvage and fuels treatment units would be

dead material that would not further reduce evapotranspiration losses within the subwatershed. Wood recruitment is likely to be higher than pre-fire levels because no wood would be harvested in RHCAs/RRs, and remaining standing dead trees would be available to the system, sustaining riparian, aquatic, and wetland habitat.

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

Alternative A

As mentioned under ACS #6, the area of influence to instream flows by the fire is relatively minimal. Seasonal peak flows occurring as a result of snowmelt are not likely to be affected by the fire, with the timing and duration of floodplain inundation from this mechanism not expected to change. Peak flows as a result of storm events may increase slightly in the lower reach of Odell Creek, with floodplain inundation possibly occurring to a greater extent during these events. Higher flows capable of channel alteration are unlikely to occur and inundation that does occur would contribute fine sediment to floodplain areas. Earlier snowmelts may also contribute additional subsurface inputs of water to the lower reach of Odell Creek and the Davis Lake system earlier in the spring, possibly reducing the length of water table inundation within the soil profile into the growing season.

Action Alternatives

Action alternatives would have minimal effect on floodplain inundation or water table elevations within the project area. Implementing any of the action alternatives would maintain the timing, variability, and duration of floodplain inundation and water table elevations currently existing following the fire because they would have minimal effect on factors that increase water yield such as evapotranspiration and snowmelt. The salvage treatments in the upland areas would not have any physical effect on floodplains and ground disturbance within activity units would be minimized to 20% of the activity area. Potentials for overland flows resulting from this disturbance actually reaching or contributing sediment to Odell Creek is very low, as discussed under ACS #5. With the implementation of the Northwest Forest Plan standards and guidelines and by applying BMPs it is anticipated that instream flows would be maintained sufficiently to create and sustain riparian, aquatic and wetland habitats.

The action alternatives would plant conifers along a 1.5 mile stretch of Odell Creek and within all proposed salvage activity units. The quicker return of conifers in these areas when compared to the no action alternative would increase evapotranspiration rates and return seasonal soil moisture regimes to pre-fire levels in a shorter time period. The conifer component would also increase snow accumulations in these areas and may slow snowmelt rates when compared to the no action alternative. Both of these factors would return the rate and timing of seasonal floodplain inundation to pre-fire conditions on a quicker timeline than the no action alternative.

As discussed under ACS #6, the proposed actions are expected to have minimal effects on base flow conditions. A foreseeable action within the Odell Creek system is a proposed stream enhancement project that will put logs into the lower section of Odell Creek in order to recreate hydrologic conditions historically provided by beaver activity. These activities would raise the water table in many areas and provide additional wetland habitats in the Davis Lake basin.

8. *Maintain and restore the species composition and structural diversity of plant communities in riparian zones and wetlands to provide adequate summer and winter thermal regulation, nutrient, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of large wood sufficient to sustain physical complexity and stability.*

Alternative A

The No Action alternative would allow post-fire, vegetative recovery in the riparian areas to continue undisturbed. Although approximately 30% of the RHCAs and RRs along Odell Creek were burned by the Davis fire, annuals and shrub re-sprouts returned during the late summer and fall of 2003. All of these elements are expected to contribute to a return of cover and diversity in upcoming growing seasons in amounts necessary to provide adequate summer and winter thermal regulation and nutrient filtering within the system. Appropriate rates of surface erosion, bank erosion, and channel migration are relatively low in a spring fed and weir controlled system and are expected to continue at reasonable rates despite the exposure of some banks within the lower reach of the creek. The amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability within the aquatic system would be provided under post-fire conditions as dead trees along stream reaches began to fall into the stream channels and replaced those consumed by the fire.

Action Alternatives

Implementation of any action alternative would not enter or disturb the riparian zones along Davis Lake or either Odell or Ranger Creeks within the fire perimeter. Proposed treatments under the action alternatives do not include activities within RHCAs/RRs and would maintain the post-fire vegetation recovery within the riparian zone. Effects to the species composition and structural diversity of plant communities in riparian areas and wetlands and their capability to provide adequate summer and winter thermal regulation and nutrient filtering would be the same as those described for Alternative A. Appropriate rates of surface erosion, bank erosion, and channel migration are also not expected to be affected by proposed salvage or fuels treatment activities on uplands within the Odell or Davis Lake subwatersheds. Although coarse woody material would be removed from within the subwatersheds, it would be located in upland areas and would not decrease the amount available to replace that which was consumed by the fire within or adjacent to riparian areas.

9. *Maintain and restore habitat to support well distributions of vertebrate riparian dependent species.*

There is no salvage proposed within the area extending well beyond riparian buffers on Odell Creek, or Ranger Creek stream channels, or within the riparian buffer of Davis Lake. All alternatives maintain post-fire native plant, invertebrate and vertebrate riparian habitats. Habitats would be allowed to restore under natural, vegetative succession. Odell creek would be further enhanced by supplemental hardwood planting. The fire removed vegetation creating a drier environment. Supplemental planting of hardwoods would provide shade and increased moisture for recovery of pre-fire invertebrate populations. The hardwood planting would also increase the diversity of vegetation from the lodgepole monoculture that existed prior to the fire. Restoring diversity to what was there historically would provide habitat for vertebrate species dependent on hardwoods.

Botany

Botany Introduction

A Biological Evaluation was conducted and documented in a Botany Report for Davis Fire Recovery Project (Close 2003). This section of Chapter 3 describes the current condition and expected environmental effects on Threatened, Endangered, or Sensitive plant species as well as Survey & Manage species from the Northwest Forest Plan, as described in the Botany Report.

The Biological Evaluation was conducted to comply with requirements of the Endangered Species Act of 1973, as amended. The Forest Service Manual and the Deschutes National Forest Land and Resource Management Plan (LRMP) (USFS 1990) both state that habitat for sensitive plant and animal species shall be Managed or Protected to ensure that the species do not become threatened or endangered, the LRMP states management guides (now referred to as Conservation Strategies) are to be developed and used. (A conservation strategy is the Forest Service's documentation for the management actions necessary to conserve a species, species group, or ecosystem.) The Forest Service Manual states habitats for all existing native and desired nonnative plants, fish, and wildlife should be managed to maintain at least viable populations for each species. A viable population consists of a number of individuals adequately distributed throughout their range necessary to perpetuate the existence of the species in natural, genetically stable, self-sustaining populations (Phillips and Wooley 1994).

The Northwest Forest Plan (USDA/USDI 1994) and the Final Supplemental Environmental Impact Statement (FSEIS) for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measures Standards and Guidelines (USDA/USDI 2001) established Standards and Guidelines for Survey and Manage species listed in the Northwest Forest Plan that amended the LRMPs for forests in the area covered by the NWFP.

The extent of the surveys within the Davis Fire Recovery Project meets requirements for survey for Proposed, Threatened, Endangered, Sensitive, Survey and Manage, and Protection Buffer species and their habitats for which the Forest Service is responsible.

This project complies with the 2004 Record of Decision to Modify the Survey and Manage Mitigation Measure Standards and Guidelines.

Analysis Method and Survey Results

Plant survey records and Biological Evaluations for projects in the watershed as well as the area of the Davis Fire were reviewed to determine sites and habitat for PETS (potential, endangered, threatened, and sensitive) and Survey and Manage (S&M) plant species and Noxious Weeds found during previous surveys. Plant survey records and biological evaluations for projects are located at the Crescent Ranger District.

Forty-six percent of the area within the Davis Fire perimeter has been surveyed between 1996 and 2003 for PETS (and Survey and Manage species in the Northwest Forest Plan (as amended by the Survey and Manage FEIS, 2001, and updated by the Annual Species Reviews for 2001 and 2002). The areas surveyed are well distributed across the landscape within the fire perimeter and are representative of the different habitat attributes that are present in the area -- such as plant association, seral stage, elevation, slope, aspect, and topographic position.

No PETS plant species were found in the areas surveyed in or near the Davis Fire area. One Survey and Manage plant was found to occur at the spring that is the source of Ranger Creek and for a short distance downstream of the spring. The Survey and Manage leafy liverwort, *Tritomaria exsectiformis*, was found during surveys in 1999 on well-rotted moist woody debris in Ranger Creek. The site was revisited by the District Botanist on July 18, 2003. The fire burned vegetation to the water's edge in many places along Ranger Creek and heat from the fire desiccated mosses and liverworts on woody debris in the stream. Vegetation was still green and relatively unaffected by the fire in a small area around the spring, where *Tritomaria exsectiformis* occurs.

Botany Existing Condition

Threatened, Endangered and Sensitive Plants

After reviewing the Geographical Information System (GIS) Sensitive Plant layer, past survey information, and field visits, sensitive plant species were not found to occur within the Davis Fire perimeter. Areas surveyed for other projects in the Davis Fire area total 9671 acres or 46% of the area. Sensitive plants were not found to occur in the areas surveyed within the Davis Fire perimeter. The survey units are well distributed across the landscape in the Davis Fire project area and are representative of the different habitat attributes that are present in the area – such as plant association, seral stage, elevation, slope, aspect, and topographic position.

Table 3.124 Plant Prefield Review

R6 Sensitive Plant Species Documented or Suspected on the Deschutes National Forest	Status*	Range	Local Habitat	Occupied Habitat in Planning Area?	Suitable Habitat in Planning Area?
Agoseris elata	List 2	Washington and Oregon Cascades	Forest openings and forest edges adjacent to wet/moist meadows, lakes, rivers, streams	No	Yes, but outside known range
Arabis suffrutscens var horizontalis	List 1	South-Central Oregon	Meadows, woods; summits, ridges; steep, exposed rock outcrops	No	No
Arnica viscosa	List 2	South –Central Oregon Cascades, California	Scree, talus gullies, and slopes w/ seasonal water runoff. Lava flows. May be in moraine lake basins or crater lake basins	No	No
Artemisia ludoviciana ssp estesii	List 1	Central Oregon	Upper riparian away from aquatic plants	No	No
Aster gormanii	List 1	Northern West Cascades	Rocky ridges, outcrops, or rocky slopes	No	No
Astragalus peckii	List 1	South-Central Oregon	Basins, benches, gentle slopes, pumice flats. Generally non-forest but known from five sites in LP openings	No	Yes
Botrychium pumicola	List 1	Central Oregon	Alpine - subalpine ridges, slopes and meadows. Montane forest openings, open forest in basins with frost pockets, pumice flats	No	No
Calamagrostis breweri	List 2	Oregon north Cascades and California	Meadows, open slopes, streambanks, lake margins	No	Yes, but outside known range
Calochortus longebarbatus var longebarbatus	List 1	South-Central Oregon and adjacent Northern California, South-Central Washington and adjacent north-central Oregon	LP-PP forest openings and forest edges of vernally moist grassy meadows, occasionally along seasonal streams	No	No

R6 Sensitive Plant Species Documented or Suspected on the Deschutes National Forest	Status*	Range	Local Habitat	Occupied Habitat in Planning Area?	Suitable Habitat in Planning Area?
Carex hystericina	List 2	Oregon, Washington, California, Idaho	Wet to moist conditions in riparian zones; in or along ditches/ canals in prairies and wetlands	No	No
Carex livida	List 2	Oregon, Washington, California, Idaho	Peatlands including fens and bogs; wet meadows with still or channeled water	No	No
Castilleja chlorotica	List 1	Oregon East Cascades	PP, LP, mixed conifer forest openings. PP at lower, LP at mid, mixed conifer at highest elevations	No	Yes
Cicuta bulbifera	List 2-ex	East Cascades Oregon and Washington	Shoreline marshes. TNC records only for margins of Klamath Lake in 1902, 1950. Persistence at these sites considered doubtful.	No	Yes, but outside known range
Collomia mazama	List 1	South-central Cascades, Oregon	Meadows (dry to wet, level to sloping); stream banks and bars; lakeshores and vernal pool margins; forest edges and openings; alpine slopes	No	Yes, but outside known range
Gentiana newberryi	List 2	Oregon East and West Cascades, California	Mixed conifer openings. Montane wet to dry meadows, sometimes adjacent to springs, streams, or lakes	No	Yes, but not in proposed treatment areas
Lobelia dortmanna	List 2	Oregon East Cascades, Washington	In water of lake, pond, slow river or stream, or wet meadow	No	No
Lycopodiella inundata	List 2	Oregon, Idaho, California, Montana – circumboreal	Deflation areas in coastal back-dunes; montane bogs, including Sphagnum bogs; less often, wet meadows.	No	Yes, but not in proposed treatment areas
Lycopodium complanatum	List 2	Oregon, Idaho, Washington +	Edges of wet meadows; dry, forested midslope with 25% canopy cover	No	Yes, but outside known range
Ophioglossum pusillum	List 2	Oregon, California, Idaho, Washington +	Dune deflation plains; marsh edges; vernal ponds and stream terraces in moist meadows	No	Yes, but outside known range
Penstemon peckii	List 1	Oregon East Cascades	PP openings, open PP forests; pine/mixed conifer openings; recovering fluvial surfaces	No	No
Pilularia americana	List 2	Oregon, California +	Alkali and other shallow vernal pools, not recently used stock ponds, reservoir shores	No	No
Rorippa columbiae	List 1	Oregon, California, Washington	Wet to vernally moist sites; meadows, fields, playas, lakeshores, intermittent stream beds, banks of perennial streams, along irrigation ditches, river bars and deltas	No	Yes, but outside known range
Scheuchzeria palustris ssp americana	List 2	Oregon, Washington, California, Idaho +	Open to canopied bogs, fens, and other wetlands where often in shallow water	No	Yes, but outside known range

R6 Sensitive Plant Species Documented or Suspected on the Deschutes National Forest	Status*	Range	Local Habitat	Occupied Habitat in Planning Area?	Suitable Habitat in Planning Area?
Scirpus subterminalis	List 2	Oregon, Washington, California, Idaho +	Generally submerged to emergent in quiet water 2-8 dm deep, in peatlands, sedge fens, creeks, ditches, ponds and lakes	No	Yes, but not in proposed treatment areas.
Thelypodium howellii ssp howellii	List 2	Oregon East Cascades, California	No recent collections; closest TNC sites are Paulina Marsh, Tumalo State Park, Camp Polk, and Big Summit Prairie	No	No

* **Oregon Natural Heritage Program (ONHP) List 1:** Contains species which are endangered or threatened though their range or which are presumed extinct; **ONHP List 2:** Contains species which are threatened endangered or possibly extirpated from Oregon, but more common or stable elsewhere.

Past survey records, the Interagency Species Management System database, GIS, and field visits have determined that there is one species of a Survey and Manage Plant, *Tritomaria exsectiformis,* found to occur in the Davis Fire area. It is located in the Ranger Creek Spring and for a short distance downstream. *Tritomaria exsectiformis*, a leafy liverwort, was found during surveys in 1999 on well-rotted logs that are in contact with the wet ground or water in the spring and downstream from the spring. The site was revisited by the District Botanist on July 18, 2003 after the fire was contained. Even though the mosses and liverworts on some of the woody debris in the stream were affected by the heat of the fire, *Tritomaria exsectiformis* was observed to be relatively unscathed by the fire in the site at the spring.

Appropriate potential habitats for Survey and Manage plants along Odell Creek were surveyed in 1999 and again post-fire in October 2003; no S&M plants or suitable habitat were found during those surveys.

Survey and Manage Plants

Table 3.125 Survey and Manage Prefield Review

Survey and Manage Plants Documented or Suspected to Occur on the Deschutes NF	Status[2]	Range	Local Habitat	Occupied Habitat in Planning Area?	Suitable Habitat in Planning Area?
Schistostega pennata	Cat A Moss	Oregon, Washington	On mineral soil in damp caves and crevices and on the soil-bearing root masses of fallen trees. Requires humid, heavily shaded sites.	No	Yes, but not in proposed treatment areas
Tritomaria exsectiformis	Cat B Liverwort	Central Oregon, Olympic Peninsula	On damp, rotten logs and limbs associated with seeps, springs and other low volume perennial flows	Yes, Ranger Creek	Yes, Odell Creek
Bridgeoporus nobilissimus	Cat A Fungus	Western Oregon	Mesic to wet microsites in forests of all seral stages in Pacific Silver Fir Zone on large diameter, dead noble or pacific silver fir	No	No

[2] **Cat A:** Survey and Manage Category A -- Rare, Predisturbance Surveys Practical; **Cat B:** Survey and Manage Category B – Rare, Predisturbance Surveys Not Practical

Botany Environmental Consequences

The following table summarizes the effects determination for Sensitive Plant species in the Davis Fire area.

Table 3.126 Summary of Conclusions of Effects for Sensitive Plant Species

Species	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
Agoseris elata	NI	NI			
Arabis suffrutscens var horizontalis	NI	NI	NI	NI	NI
Arnica viscosa	NI	NI	NI	NI	NI
Artemisia ludoviciana ssp estesii	NI	NI	NI	NI	NI
Aster gormanii	NI	NI	NI	NI	NI
Astragalus peckii	NI	NI	NI	NI	NI
Botrychium pumicola	NI	NI	NI	NI	NI
Calamagrostis breweri	NI	NI	NI	NI	NI
Calochortus longebarbatus var longebarbatus	NI	NI	NI	NI	NI
Carex hystericina	NI	NI	NI	NI	NI
Carex livida	NI	NI	NI	NI	NI
Castilleja chlorotica	NI	NI	NI	NI	NI
Cicuta bulbifera	NI	NI	NI	NI	NI
Collomia mazama	NI	NI	NI	NI	NI
Gentiana newberryi	NI	NI	NI	NI	NI
Lobelia dortmanna	NI	NI	NI	NI	NI
Lycopodiella inundata	NI	NI	NI	NI	NI
Lycopodium complanatum	NI	NI	NI	NI	NI
Ophioglossum pusillum	NI	NI	NI	NI	NI
Penstemon peckii	NI	NI	NI	NI	NI
Pilularia americana	NI	NI	NI	NI	NI
Rorippa columbiae	NI	NI	NI	NI	NI
Scheuchzeria palustris ssp americana	NI	NI	NI	NI	NI
Scirpus subterminalis	NI	NI	NI	NI	NI
Thelypodium howellii ssp howellii	NI	NI	NI	NI	NI

NI = No Impact

Alternative A – No Action

Direct and Indirect Effects

The No Action alternative would leave the proposed activity areas in their post-fire condition. Additional fire recovery activities would not occur within the Davis Fire project area, other than completion of activities proposed by the Burned Area Emergency Recovery Plan (BAER Plan). However, custodial activities such as routine maintenance on roads and emergency measures such as wildfire suppression would continue.

Since no sensitive plant sites or suitable habitat were found during surveys, there will be no direct or indirect effects to these species in the Davis Fire project area if Alternative A is selected.

Also, there is very little potential for any direct or indirect effects to the Survey and Manage species *Tritomaria exsectiformis* if Alternative A is selected. Although there would be very low potential for activities to affect the site, some of the trees that afford shade to the site may die as a result of the wildfire. Monitoring for survival and recovery would continue as a result of implementation of the Burned Area Emergency Rehabilitation (BAER) plan.

Selection of this alternative would contain a somewhat of an elevated risk to populations due to another wildfire that could originate from the developed campground (a potential wildfire ignition source) approximately one mile away.

Alternatives B, C, D, and E

Direct and Indirect Effects

Since no sensitive plant sites or suitable habitat were found during surveys, there will be no direct or indirect effects to these species in the Davis Fire project area if an action alternative is selected.

Direct and indirect effects to the Survey and Manage plant, *Tritomaria exsectiformis*, would be the same for all action alternatives. The greatest potential effect would be direct contact with equipment or felling of trees on individual plant populations. The nearest salvage activities are proposed on Ranger Butte for Alternatives B and C. These activities would be well outside Riparian Reserves, therefore, direct contact is highly unlikely. Also, potential from sediment transport that could affect populations is considered very low (reference the soils and hydro sections).

Selection of these alternatives would contain risk reduction from another wildfire due to strategic small diameter fuels removal concentrated around the developed campgrounds.

Cumulative Effects for All Alternatives

Reasonably foreseeable future actions in addition to those listed for direct and indirect effects include log placement and improving culverts for fish passage in Odell Creek and planting spaded trees in East and West Davis Campgrounds.

Sensitive plant sites or habitat were not found to occur in or near the project area; therefore, there will be no cumulative impacts to any plant species on the Region 6 Forester's Sensitive Plant List.

Because of the lack of suitable habitat or individual populations, there are no potential cumulative impacts identified for Proposed, Threatened, Endangered, Sensitive, or Survey and Manage plant species. Potential direct and indirect effects to *Tritomeria exsectiformis* are discussed.

Culturally Important Plants

Many native plants are considered "sensitive" because local American Indian tribes consider the use of these plants, and the activities associated with them, a means of maintaining connections to their heritage and preservation of their cultural identity.

During scoping and cultural resource consultation with area American Indian tribes, we have not received any direct input on "sensitive" or traditional cultural plants. The groups that may have an interest in the project area include the Burns Paiute Tribe, the Confederated Tribes of the Warm Springs Reservation, and The Klamath Tribes. Patterns of native life have changed dramatically in the last 500 years, yet traditions remain that tie these peoples to the native plants found in the project area, whether there is modern use of them or not. An example of this is an annual ceremony of the Klamath Tribes related to the yellow water lily (*Nuphar polysepalum)*, an aquatic species, that today, grows in Davis Lake.

Native plants found today in the project area are representative of current environmental conditions. Since these conditions have been subject to change over time, so too, have the native plants changed. Trees, shrubs, forbs, root crops, sedges, and grasses supplied such needs as food, tobacco, chewing gum, seed sources, teas, medicine,

insect repellants, dyes, and materials for basketry and other building needs. Limited information is available about native plant use in the past in the project area. It may be inferred from evidence at archaeological sites in the area. Tools that fall into a category called "ground stone" are documented, including mortars, hopper mortars, manos, and metates. Grinding, mixing, pounding, and cooking activities are all indicated by these clues from the past that were left behind.

There is also evidence of past native uses of plants dating to about the time of contact with non-native populations. A number of ponderosa pine trees have one or more scars formed by removing a segment of bark. The target part of this plant was likely the sweet cambium (growing) layer under the bark. These trees have healed somewhat, but the scars are hard to miss when identified. Analysis of core samples from a sample of these trees suggests that they are approximately 200 years old. This time is coincident with the arrival of Euroamericans with the Corps of Discovery under Lewis and Clark.

Environmental Consequences

Based on the lack of input about continued cultural use of native plants by American Indian tribes and the nature of the proposed action, no effects on the yellow water lily or ponderosa pine trees are anticipated. This is because no live ponderosa pine will be harvested and there are no activities planned for the lake itself, which is habitat for the water lily.

Noxious Weeds

Noxious Weed Introduction

A Noxious Weed Report was prepared for the Davis Fire Recovery Project by the Crescent District Botanist (Close 2004). It includes a risk assessment of the introduction and spread of invasive plant species, including noxious weeds, for activities proposed in the project.

National Direction

The National Forest Management Act (1976) specifies that National Forest System lands "provide for a diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives." The implementing regulations (36 CFR 219.26) for the National Forest Management Act states that "forest planning shall provide for diversity of plant and animal communities and tree species consistent with the overall multiple-use objectives." In addition, 36 CFR 219.27 (g) states that "management prescriptions shall preserve and enhance the diversity of plant and animal communities, including endemic and desirable naturalized plant and animal species, so that it is at least as great as that which would be expected in a natural forest…reductions in diversity of plant and animal species from that which would be expected in a natural forest, … may be prescribed only where needed to meet multiple-use objectives. Planned type conversions shall be justified by an analysis showing biological, economic, social, and environmental design consequences, and the relation of such conversions to the process of natural change."

The Noxious Weed Management Act (1974) contains provisions to prevent the dissemination of noxious weeds. Other provisions in the act authorize the cooperation of Federal agencies with agencies of State, districts, farmers' associations and similar organizations or individuals in carrying out operations or measures to eradicate, suppress, control or retard the spread of any noxious weed. In addition, 36 CFR 222.8 acknowledges the Agencies obligations to work cooperatively in identifying noxious weed problems and developing control programs in areas where National Forest System lands are located.

The USDA Forest Service issued a Guide to Noxious Weed Prevention Practices in July 2001. This Guide provides a comprehensive directory of weed prevention practices for use in Forest Service planning and wildland resource management activities and operations. The Guide supports implementation of the February 3, 1999 Executive Order on Invasive Species.

Forest Direction

The Deschutes National Forest Land and Resource Management Plan (LRMP or Forest Plan) contains the following direction for noxious weed management: Standard FH-8, page 4-37 states that herbicides would be used in conjunction with the Mediated Agreement and Record of Decisions (1988 and 1992) for the Final Environmental Impact Statement (Vegetation Management FEIS) for Managing Competing and Unwanted Vegetation. Other sections of the LRMP make indirect references to maintaining habitat for wildlife species that are dependent on plant communities and habitat.

In 1998, the Deschutes National Forest Noxious Weed Control Environmental Assessment (DNF Weed EA) with its supplemental Deschutes National Forest Integrated Weed Management Plan (IWMP) was completed in accordance with the Regional Vegetation Management FEIS. The Decision Notice from this Environmental Assessment selected an alternative that allows a variety of noxious weed treatments, including herbicides (USFS 1998). Although there are no herbicide treatments proposed within this analysis, the potential effects associated with ongoing weed treatment are discussed for affected resources and are summarized within respective sections in this analysis.

The Deschutes National Forest Weed EA and IWMP identify and promote actions within the noxious weed management strategies for prevention, early treatment, maintenance, and awareness. Implementation of management strategies include analyzing the risk of noxious weed invasion during the project planning process and developing tactics to avoid introduction or spread of noxious weeds, clean equipment provisions in contracts,

actions to prevent weed introduction and spread, and suggestions for increasing awareness, both within the Forest Service and with the public, of noxious weeds and the risks they pose.

Regional Direction

Region 6 of the Forest Service is in the process of preparing an Invasive Species Environmental Impact Statement (EIS) scheduled for decision in the spring of 2004. Tiered to the Regional Invasive Species EIS, the Deschutes and Ochoco National Forests have initiated the preparation of a site-specific Invasive Species Environmental Impact Statement analyzing the effects of prevention and treatment of invasive species on the two Forests. This EIS is scheduled for decision in the Fall/Winter of 2004.

Since 1994, gathering of site location and size for all known noxious weed sites has been underway. This information has been put into GIS and has been updated on an annual basis. Currently, there are 88 noxious weed sites on Crescent Ranger District totaling approximately 4956 acres.

Under the authority of the DNF Weed EA, noxious weeds have been treated starting in 1999 using various methods, including herbicide treatments under contract with Oregon Department of Agriculture. BAER and other funding have been made available for the inventory and treatment of noxious weeds in the Davis Fire Recovery Project area. This will aid in the control of previously unknown sites, new infestations that occur as a result of fire suppression activities, and infestations that are a result of weed establishment in burned and disturbed areas.

Noxious Weeds Existing Condition

The Forest Service manages all lands within the Davis Fire Recovery Project boundary. Currently, weed infestation in the project area is relatively low. However, 2003 Davis Fire created prime habitat for noxious weeds on approximately 21,000 acres. Factors such as an ideal seed bed, reduced competition from native plants, and increased nutrients released by the fire all combine to make conditions ideal for weed seed to germinate and flourish following fire (Asher et al. 2000). Without the presence of native plant species ground cover, there is little competition against the establishment and spread of noxious weeds; noxious weeds are likely to expand from existing populations within and adjacent to the fire area.

After reviewing the GIS weed layer and past survey forms, it was determined there are 11 weed sites with 10 different species of noxious weeds covering approximately 1,921 acres within the watershed with direct potential to affect the Davis Fire area (figure 3.32). The greatest infestation within the Davis Fire is reed canarygrass (*Phalaris arundinacea*) which occupies 1,256 acres in the meadow area around Davis Lake. Bull thistle (*Cirsium vulgare*) occurs on 7 sites on 521 acres in past harvest units and along roads. Spotted knapweed (*Centaurea maculosa*) occurs on two sites on 138 acres along the Cascade Lakes Highway in the Davis Fire area. Diffuse knapweed (*Centaurea diffusa*), Canada thistle (*Cirsium arvense*), St. Johnswort (*Hypericum perforatum*), and Scot's broom (*Cytisus scoparius*) are found scattered along Cascade Lakes Highway in the same sites with spotted knapweed. Tansy ragwort (*Senecio jacobaea*) occurs on 4 acres on one site in a past harvest unit. Yellow toadflax *(Linaria vulgaris*) occurs on 1 roadside site and occupies 1 acre. Dalmation toadflax (*Linaria dalmatica*) occurs on 1 site in a past harvest unit on 1 acre.

The following are descriptions of the weed species that are known to occur in or near lands within the Davis Fire Recovery Project boundaries. These species – except for reed canarygrass which is not likely to spread from the area around Davis Lake that it presently occupies – are most likely to spread in the project area.

Reed canarygrass: Reed canarygrass (*Phalaris arundinacea*) is a cool-season perennial grass that grows successfully in northern latitudes. It can be invasive in wet habitats and so is often a target for control. Since reed canarygrass is tolerant of freezing temperatures and begins to grow very early in the spring, it can outcompete many other species. Reed canarygrass spreads within sites by creeping rhizomes and forms dense, impenetrable mats of vegetation. New sites are colonized by seeds (Lyons 1998).

Reed canarygrass has been referred to as a "Dr. Jekyll and Mr. Hyde kind of grass" (Hodgson 1968 in Lyons 1998). It is valued as a forage grass and for revegetating denuded ditchbanks. However, it can also overgrow irrigation ditches and small natural watercourses, alter soil hydrology, is poor forage for domestic stock when fresh, and invades native vegetation where it outcompetes desirable native species. Almost any moist, fertile habitat is

suitable for this species. Reed canarygrass invades and dominates wetland and riparian areas. Human-caused disturbance and alteration of water levels encourage reed canarygrass invasion (Hoffman and Kearns, 1997 in Lyons, 1998).

Crescent district records show that reed canarygrass was seeded in 1955 in the meadow area of Davis Lake site (approximately 40 pounds of seed on twenty acres, along with alta fescue, meadow foxtail, and orchard grass) and again in 1965 in the Davis Lake C&H grazing allotment when 120 pounds of seed were planted in the vicinities of the mouths of Odell and Ranger Creeks. The Davis Lake reed canarygrass site now occupies 1,256 acres (see figure 3.14). There are no current grazing allotments within or adjacent to the Davis Fire on National Forest lands.

Spotted knapweed: Spotted knapweed (*Centaurea maculosa*) is a biennial or short-lived perennial composite with a stout taproot (Mauer and Russo 1991). This species reproduces by seeds, which are dispersed by wind, passing animals, or humans. The competitive superiority of this species suggests preadaptation to disturbance (Roche et al, 1986 in Mauer and Russo 1991). The initial invasion of spotted knapweed, like other noxious weeds, is correlated highly to disturbed areas. Once a plant or colony is established though, it may invade areas that are relatively undisturbed or in good condition (Tyser and Key 1988 and Lacey et al, 1991 in Mauer and Russo 1991). The spotted knapweed sites on the Deschutes National Forest have decreased in size and numbers of plants due to manual treatments combined with treatments with herbicides.

Diffuse knapweed: Diffuse knapweed (*Centaurea diffusa*) is a highly competitive herb of the aster (sunflower) family (Asteraceae). The plants first form low rosettes and may remain in this form for one to several years. After they reach a threshold size they will bolt, flower, set seed, and then die. Thus they may behave as annuals, biennials, or short-lived perennials (Carpenter and Murray 1998a). Diffuse knapweed is a highly competitive and aggressive plant that forms dense colonies (Zimmerman 1997 in Carpenter and Murray, 1998a). It is especially adept at spreading along rights-of-way and can spread rapidly (Allred and Lee 1996 in Carpenter and Murray 1998). Disturbed lands are prime candidates for colonization, but diffuse knapweed will also invade undisturbed grasslands, shrublands, and riparian communities (Zimmerman 1997 in Carpenter and Murray 1998a). In the Davis Fire Recovery Project area, diffuse knapweed occurs along Cascade Lakes Highway and has the potential to spread in the burned area, especially along firelines.

Dalmation toadflax and common toadflax: Dalmation toadflax (*Linaria dalmatica*) and common toadflax (*Linaria vulgaris*) are perennial herbs in the figwort family (Scrophulariaceae). Both species are classified as weeds in Europe, Russia, Canada, and the United States, and are common throughout North America (Carpenter and Murray 1998b).

A toadflax plant has from 1-25 vertical, floral stems. These floral stems have thick-walled, woody zylem and supporting fibers. Flowers are bright yellow and resemble snapdragons. The taproot may penetrate one meter into the soil. Horizontal roots may grow to be several meters long, and can develop adventitious buds that may form independent plants (Carpenter and Murray 1998b).

Both species are persistent, aggressive invaders and capable of forming colonies through adventitious buds from creeping root systems. These colonies can push out native grasses and other perennials, thereby altering the species composition of natural communities. In North America, both species of toadflax are considered strong competitors. They are quick to colonize open sites, and are capable of adapting to a wide range of environmental conditions (Carpenter and Murray 1998b).

In North America, *Linaria dalmatica* and *Linaria vulgaris* primarily occur on sandy or gravely soil on roadsides, railroads, pastures cultivated fields, range lands, and clearcuts (Saner *et al*. 1995 in Carpenter and Murray 1998b). Both species of toadflax are considered strong competitors, reproduce by seed and vegetative propagation, and once established, high seed production and the ability for vegetative reproduction allow for rapid spread and high persistence (Saner *et al* 1995 in Carpenter and Murray 1998b). Both species of toadflax can adapt their growth to fit a range of habitats, and have a tolerance for low temperatures and coarse textured soils (Carpenter and Murray 1998b).

Tansy ragwort: Tansy ragwort (*Senecio jacobaea*) is a member of the groundsel tribe (*Senecioneae*) of the sunflower family (*Asteraceae*). It is a biennial or short-lived perennial with one to a few coarse, erect purplish-red stems, simple except above (Macdonald and Russo 1989).

Tansy ragwort is a disturbance area plant found on creek bottomlands, in pastures, forest clearcuts, overgrazed pasture, and along roadsides (Macdonald and Russo 1989). On the Crescent Ranger District it is found mainly in clearcuts and also along roadsides.

Scot's broom: Scot's broom (*Cytisus scoparius*) is a perennial shrub of the legume (Fabaceae) family. Scot's (or Scotch) broom grows best in dry, sandy soils in full sunlight (Hoshovsky 1986). Scot's broom invades pastures and cultivated fields, dry scrubland and "wasteland", native grasslands and along roadsides, dry riverbeds and other waterways (Gilkey 1957, Johnson 1982, Williams 1981 in Hoshovsky 1986). Although it is primarily found west of the Cascades, it has been found growing on the eastern slopes as well (Gilkey 1957 in Hoshovsky 1986). It does not do well in forested areas but invades rapidly following logging, land clearing, and burning (Mobley 1954, Williams 1981 in Hoshovsky 1986). On Crescent Ranger District, Scot's broom occurs mainly along roadsides from seeds most likely transported from the west side Cascades by vehicles.

Bull thistle: Bull thistle (*Cirsium vulgare*) is a biennial with a fleshy taproot. It reproduces solely from seeds that are dispersed by water, animals, and human activities. Disturbed areas are prime habitat for bull thistle to invade (Beck 1999). On the Deschutes National Forest, bull thistle has been sighted, but has not proven to be an aggressive noxious weed. When it occurs on a disturbed site, it seems to decrease and disappear when native vegetation regains its pre-disturbance levels. Due to a combination of limited funds and noxious weed species of higher priority, bull thistle has not been actively treated on the Deschutes National Forest.

St. Johnswort: St. Johnswort (*Hypericum perforatum*) is a perennial species with a deep penetrating taproot. It is commonly referred to as goatweed or Klamath weed. This species can become established in degraded or pristine forest or rangelands. Any soil disturbance will decrease competition for St. Johnswort and will cause it to increase (Piper 1999). St. Johnswort is common along roadsides on all the major roads on Crescent Ranger District, including on Road 44 as well as on the Wickiup Dam on the adjoining district.

There is also potential for new weed species to be introduced the Davis Fire Recovery Project area. Of particular concern is:

Yellow star thistle: Yellow star thistle (*Centaurea solstitialis*) is a winter annual that depends upon seeds for reproduction (DiTomaso 2001). The seeds are primarily dispersed by birds, however, animals, whirlwinds, humans, and vehicles also disperse seeds. It has been noted to invade sites that have had recent disturbance. In 2003, yellow star thistle was found to occur on two sites on Highway 58 on Crescent Ranger District.

All noxious weed sites within and adjacent to the Davis Fire Recovery Project area have been given top priority for treatment for at least the next three years (2004-2006). According to Dave Langland with the Oregon Department of Agriculture (pers. communication 2004), because of ongoing treatment, knapweed populations within and adjacent to the Davis Fire perimeter are steadily declining.

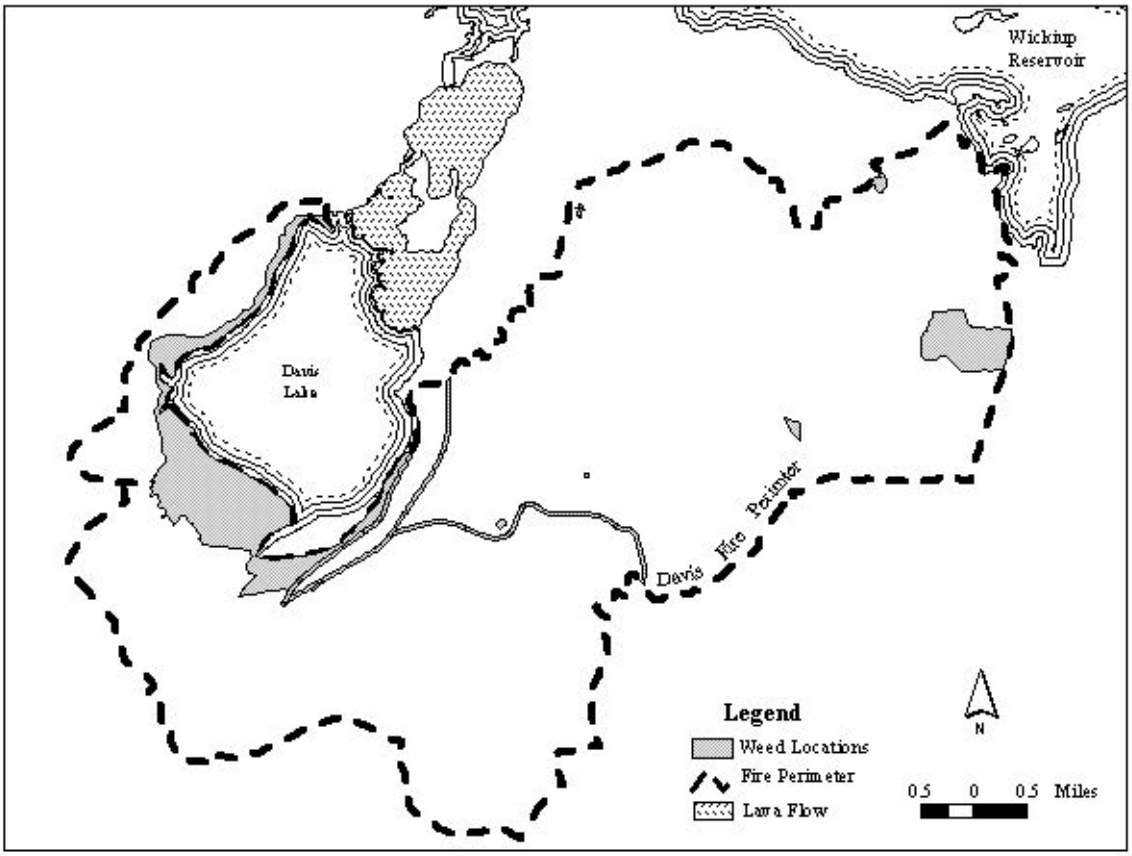


Figure 3.29 Location of Existing Noxious Weed Populations within the Davis Fire Recovery Project Area

Noxious Weeds Environmental Consequences

Direct and Indirect Effects

Common to all Alternatives

Noxious weed spread may occur in the Davis Fire Recovery Project area, regardless of which alternative is chosen. The fire created suitable habitat for weeds, and weed seeds are readily dispersed by wind, vehicles, humans, and animals. Additionally, as described in the cumulative effects section, fire suppression activities increased the potential for introduction or spread of noxious weeds to the area. Also ground-disturbing activities on adjacent private lands were considered as potential for weed spread into the area.

The consequences of noxious weed infestation can include alteration of the structure, organization, or function of ecological systems (Olson 1999). Noxious weeds can increase soil erosion, leading to a disproportionate loss of biologically active organic matter and nitrogen. Noxious weeds have the ability to deplete soil water and nutrients to levels lower than native plant species can tolerate, allowing noxious weeds to outcompete native vegetation. Many noxious weeds are early successional species, meaning they colonize areas that have been recently disturbed. Since noxious weeds have the ability to deplete available resources to lower levels than native vegetation, they can quickly dominate disturbed sites. When noxious weeds dominate over native plant communities, native plant species diversity is decreased. Noxious weeds can out-compete native species because they produce abundant seed, have fast growth rates, have no natural enemies, and are often avoided by large herbivores. Some noxious weeds

also produce secondary compounds, which can be toxic to other native plant species or animals. Weed infestation can therefore lead to a decrease in native plant species, which can alter the ability of wildlife to find suitable edible forage.

At the watershed level, noxious weeds can alter the seasonal water flow. Noxious weeds create more erosion than native vegetation because they have fewer shallow roots, which would soak up and hold water. Noxious weeds also have less canopy cover than native plants, increasing the amount of sunlight directly hitting the soil, which increases the amount of water evaporated from the soil surface. This can create a hard crust on the soil, making it more difficult for additional moisture to penetrate. Soil surface run-off is increased when moisture cannot penetrate into the soil. The moisture held by the soil helps maintain stream levels throughout the summer. When noxious weeds are present, there is an increase in erosion and surface run-off, leading to deterioration in watershed conditions.

The Davis Fire Recovery Project area will be monitored for noxious weeds under BAER for up to three years, regardless of the alternative selected. Also, existing noxious weed populations analyzed under the 1998 Deschutes National Forest Noxious Weed Environmental Assessment would continue to be treated. These actions would aid in the early identification, prevention, and control of identified and unknown sites, new infestations with potential to occur as a result of fire suppression activities, and infestations that are a result of weed establishment in burned and disturbed areas.

In the short term, the alternatives would affect the potential for noxious weed infestation in the project area in two main ways. First, for weed populations to take hold, they need a receptive environment. The wildfire created ideal conditions and any additional risk would be associated with ground-disturbing activities. Risk of ground disturbance can be rated using acres proposed for treatment (ranging from 0 in “No Action” to 6,355 acres in Alternatives B and C) as well as the harvest method used. In the active management scenario, the least potential for ground disturbance would exist with helicopter logging, while ground based tractor logging would be the greatest. Second, the seeds for noxious weeds need a vector to be introduced into the fire area. Seeds and propagules can be transported by environmental conditions or animals, but mostly from motorized vehicles and equipment.

In the long term, the alternatives would affect the recovery of native vegetation and the reduction of open, disturbed habitat over time. Various levels of reforestation (natural and artificial) within the design of the alternatives would have an effect on the rate of return of tree canopy and native vegetation to reduce the amount of open habitat suitable for noxious weed establishment. Likewise, access management is a factor in lowering potential weed introduction and spread.

Alternative A

In the short term, noxious weed spread may occur in the project area if Alternative A is chosen. However, because of the lowest level of additional ground disturbance resulting from active management, Alternative A has the lowest probability of spreading and introducing noxious weeds when compared to Alternatives B, C, D, or E (see table 3.117). The probability of the introduction and spread of noxious weeds would be considered as “high”, due to conditions created by the fire

Alternative A, the No Action Alternative, would leave the proposed activity areas in their post-fire condition. There would be no salvage, reforestation, road closure or decommissioning, fuels reduction, or temporary road construction. Other than hazard trees felled for public safety, all snags would be retained. Monitoring for weed populations under the Burned Area Emergency Recovery (BAER) plan would continue. Without additional ground-disturbing activities occurring, noxious weed habitat and the potential for new introductions would not be increased above the present level. The existing 1,921 acres of noxious weeds in the Davis Fire Recovery Project area (including 1,256 acres of reed canary grass at Davis Lake), would be monitored and given priority for treatment for at least the next 3 years.

In the No Action Alternative, the existing level of vehicle access would be provided. Alternative A would rely on passive management, or natural regeneration for reforestation. Especially within areas of severe mortality in mixed conifer were there is very little conifer seed source available for natural regeneration, this could cause a delay in the length of time for forested canopy to grow and assist in shading out noxious weeds (reference the vegetation section). This would have long term implications, possibly decades, before the threat of weed infestation from newly introduced or existing populations is lowered.

Alternatives B, C, D, and E

Alternative B is the proposed action and maximizes ground-based logging methods. Advanced harvest systems (helicopter or skyline yarding on 2,570 acres) are proposed where potential for sediment transport is highest and on slopes where access is marginal. Areas to reforest (8,400 acres) were identified as the proposed salvage units, existing plantations that were in the high/moderate intensity burn areas, portions of the lodgepole flat area south of Davis Lake after two years of monitoring for artificial regeneration success, and riparian planting along Odell Creek. All other areas would rely upon natural regeneration.

Small diameter fuel reduction was strategically placed over the landscape to reduce the risk of a subsequent fire spreading from high-use areas such as campgrounds on Davis Lake and along Highway 46.

Construction of temporary roads increases short term risk and are proposed for 11 miles in Alternative B, 9 miles in Alternative C, and 3 miles in Alternative D. Mitigation measures required for construction of temporary roads and road decommissioning, such as weed free equipment and monitoring is expected to be effective in reducing the risk of weeds from this activity. Alternative E uses helicopter logging exclusively and would not require construction of temporary roads.

Mitigation Measures (page 2-36): Timber sale contracts, road packages, stewardship pilot projects, and service contracts are required to include provisions to minimize the risk of the introduction and spread of invasive plants, pursuant to Executive Order 13112 dated February 3, 1999 (Joyner, 2002). These provisions state that the Purchaser/Contractor shall certify in writing that off-road equipment is free of noxious weeds prior to the start-up of timber sale, road, or other activities requiring off-road equipment operations and for subsequent moves of equipment to the Sale Area (USDA Forest Service, Region 6, 2002). Being free of noxious weeds means the equipment would not have soil, seeds, vegetative matter, or other debris that could contain or hold seeds (USDA Forest Service, Region 6, 2002). "Off-road equipment" includes all logging and road construction machinery, service contract equipment, except for log trucks, chip vans, service vehicles, water trucks, pickup trucks, cars, and similar vehicles (USDA Forest Service, Region 6, 2002). Equipment such as skyline yarders, brush cutters, flailers, or other equipment, which operate from the road surface shall be considered off-road equipment (USDA Forest Service, Region 6, 2002. This direction applies to road construction and reconstruction, logging, building of temporary roads, service contracts, or any project with operations involving "off-road equipment" (USDA Forest Service, Region 6, 2002). The purchaser must also clean off-road equipment prior to moving between cutting units that are known to be infested with noxious weeds and units that are free of noxious weeds (USDA Forest Service, Region 6, 2002). This requirement would reduce the potential for introduction of weed seeds and propagules during implementation of the action alternatives.

These measures are part of the design of the action alternatives and have been noticeably effective in reducing the rate of infestation since their implementation on the forest (personal communication with Close, 2004).

Considering active management components discussed in this section, from a short term perspective, a ranking of the Alternatives with the least risk in ascending order would be D, E, C and B.

From a long term perspective, because of the active reforestation scenario and the most rapid attainment for canopy cover, Alternatives C and B would be the highest, followed by D and E.

Cumulative Effects

Common to All Alternatives

Suppression activities within the Davis Fire area include retardant drops, back-fire/burnout operations, and dozer lines. Approximately 11 miles of dozer line was constructed and drop points, staging areas, safety zones, and turn-arounds/parking caused disturbance on approximately 15 acres. Roads in the Davis Fire area had surface drainage structures constructed (water bars and drain dips on 3 digit roads) or were graded and shaped (2 and 4 digit roads). The dozer line and other disturbed areas created prime habitat for noxious weeds. With the magnitude of the Davis Fire, additional resources were brought in from places outside the southern Deschutes County, northern Klamath County area. This influx of equipment, personnel, and vehicles may have introduced noxious weed seeds. There is a possibility that the amount of noxious weed sites and density will increase, especially on the rehabilitated dozer

lines. There is also a possibility that different noxious weed species will appear due to the broad geographical range the equipment, personnel, and vehicles came from.

Noxious weed inventory and treatment has been occurring on the Deschutes National Forest in past years. Accurate documentation of noxious weed sites began in the early 1990s. After the Deschutes National Forest Noxious Weed Control Environmental Assessment was approved in 1998, chemical treatment was permitted on selected sites, including the section of Cascade Lakes Highway in the Davis Fire area. Past treatment of noxious weeds has reduced the density of weeds on many sites. Treatments authorized by the 1998 Deschutes National Forest Weed EA have been implemented annually on weed sites in an adjacent to the Davis Fire Recovery Project area. Chemical treatment of spotted and diffuse knapweeds and common toadflax on Cascade Lakes Highway has taken place since 1999, on a total of about ½ acre within the fire perimeter, with dicamba applied at a rate of 17 ounces over the ½ acre, with a handgun targeting the individual weed plants. Chemical treatments were followed with hand-pulling of the weeds that remained after treatment with herbicide. Hazard tree removal was conducted along selected roads, including Cascade Lakes Highway, within the fire area.

Present and Future Foreseeable Activities:

Approximately 1,375 acres of vegetation management with a previous decision is pending implementation within or near watersheds containing the Davis Fire (Seven Buttes Return and Crescent Wildland Interface Projects). Both of these projects also have a risk assessment rating of "High" for potential introduction or spread of noxious weeds. Also, a foreseeable action would be the Five Buttes Interface project (formerly Seven Buttes Return), this project proposal includes thinning, large tree culturing, and salvage on approximately 7,100 acres, which would be classified as ground-disturbing activity. Also, planting spaded trees in East and West Davis Campgrounds, and restoration of riparian habitat along the portion of Odell Creek within the fire area. Activities proposed for Odell Creek include placing logs in the stream and planting riparian shrubs, including willow, alder, and bog birch.

The District is preparing for a morel harvesting season in 2004. To limit the spread of noxious weeds from mushroom harvesters, a limited entry system along major roads where hazard trees have been removed is part of the permit system. Motorized vehicle travel and parking would not be allowed off the road system. This measure is anticipated to be effective with additional law enforcement presence. Ongoing monitoring of noxious weeds would continue as specified by the Burned Area Emergency Rehabilitation.

Access management is a foreseeable action. Based on recommendations in the Roads Analysis, motor vehicle access would be reduced on a net 28 miles within the fire perimeter. This would have a positive long term benefit in lowering the risk for spread of weed populations.

Alternative A

From a short term cumulative perspective, this alternative would have the least risk of weed spread and introduction of new populations above present levels.

From a long term cumulative perspective, given all the activities within the watershed and the relative time for conifer species to achieve a canopy cover sufficient to shade out noxious weeds, this alternative would rank the poorest in achieving this objective among all alternatives.

Alternatives B, C, D, and E

Alternatives B and C propose ground disturbing activities on a total of approximately 7,805 acres in the project area. Alternative B proposes 11 miles of roads be temporarily constructed and 28 net miles of road closure or decommissioning. Alternative C is very similar in except the harvest method is with a helicopter and the temporary road construction would only be needed on 9 miles. Planting of conifer trees would occur on 8,400 acres. Cumulative ground disturbing activities from salvage logging and fuels reduction would occur on an estimated 37 percent of the project area.

Alternative D proposes ground disturbing activities on 2,795 acres and similar access management proposals, except temporary road construction would be needed on only 3 miles. Planting of conifer trees would occur on

2,030 acres. Ground disturbing activities such as salvage logging and fuels reduction would occur on approximately 9 percent of the project area.

Alternative E proposes ground disturbing activities on 5,040, similar access proposals, and no construction of temporary roads for a total of 24 percent of the project area. Planting of conifer trees would occur on 3,910 acres.

Active management scenarios range from an increase of ground disturbance from (9-37 percent), placing the entire area at greater short-term risk given the past, present, and foreseeable future activities. Mitigations including prevention, along with early detection and treatment would be used to help offset some of the risk associated with weed introduction and spread in the Davis Fire Project area.

In looking at longer term objectives and risk, quicker recovery to a forested condition could lessen the ongoing risk of weed invasion from future vegetation management as well as recreation and the gathering of special forest products. Also, eventual implementation of the road closure recommendations from the Roads Analysis process will lessen the long-term risk.

Risk Assessment for All Alternatives

The assessment of the risk of the introduction and spread of noxious weeds associated with activities proposed in the alternatives is based on the amount of ground disturbance that would occur for each alternative. For instance, ground-based logging systems would cause more ground disturbance than skyline or helicopter logging systems. Higher numbers (acres) of ground disturbing activities equates to an increase the risk of introducing or spreading noxious weeds. Table 3.116 displays the acreages of potential ground disturbing activities associated by alternative. The short term risk for all the alternatives and a ranking from least (#1) to highest (#5) is also displayed.

Alternative A, the No Action alternative, poses the least short term risk of introduction and spread of noxious weeds when compared to the action alternatives. No commercial salvage, fuels reduction activities, or reforestation, are proposed in this alternative, therefore there will be no additional ground disturbance above that caused by the fire.

Alternative B poses the highest risk for noxious weed spread and introduction based on the greater number of acres for ground-based logging systems and the higher number of miles of temporary roads, which would potentially cause more soil disturbance.

Alternative C poses the next highest risk with the number of acres of aerial logging increasing and ground-based logging systems and miles of temporary road construction decreasing.

Alternative D poses less risk of the introduction and spread of noxious weeds than Alternatives B and C, and more risk than Alternative E. Significantly fewer acres are proposed for salvage and reforestation treatments, therefore there will be less ground disturbance and less risk of the introduction and spread of noxious weeds.

Alternative E poses the least risk of the introduction and spread of noxious weeds of all the action alternatives, but a higher risk than the No Action alternative. Even though a higher number of acres are proposed for salvage than in Alternative D, those acres are proposed to be harvested by helicopter and there would be no construction of temporary roads.

The table on the next page displays a comparison of the noxious weed risk by alternative.

Table 3.127 Noxious Weed Comparative Risk Assessment

Action	Alternative A (No Action)	Alternative B	Alternative C	Alternative D	Alternative E
Commercial Salvage	0	6,355	6,355	1,045	3,290
Logging System	0				
Ground-based		3,785	3,130	850	0
Skyline		800	190	195	0
Helicopter		1,770	3035	0	3,290
Fuels Reduction	0	1,450	1,450	1,750	1,450
Planting of Conifer Trees	0	8,400	8,400	2,030	4,070
Temporary Rd. Construction	0	11.0	9.0	3.0	0
Short Term Actual Risk	**High**	**High**	**High**	**High**	**High**
Comparative Ranking for Best Short Term Weed Risk (1 being lowest)	**#1**	**#5**	**#4**	**#3**	**#2**

Cultural Resources

Cultural Resources Introduction

This section of Chapter 3 discusses the existing conditions after the 2003 Davis Fire and the potential effects on cultural resources as a result of the proposed management activities. Cultural resources include historic and archaeological sites and resources used by humans in the past, historic and prehistoric. The information presented here is derived from two documents prepared by the District Archaeologist: Heritage Program Input to the Davis Fire Salvage EIS and the Cultural Resource Inventory and Consultation Report for the Davis Fire Salvage EIS. These documents record the survey efforts undertaken, existing condition of the cultural resources in the project area, proposed mitigation and monitoring, and the expected effects from the alternatives.

Management direction for cultural resources is found in the Deschutes National Forest Resources Management Plan, in the Forest Service Manual section 2360, in Federal Regulations 36CFR64 and 36CFR800 (amended May 1999), and in various federal laws including the National Historic Preservation Act (NHPA) of 1966 (as amended), the National Environmental Policy Act, and the National Forest Management Act.

In general, the existing management direction asks the Forest to consider the effects on cultural resources when considering projects that fall within the Forest's jurisdiction. Further direction indicates that the Forest will determine what cultural resources are present on the forest, evaluate each resource for eligibility to the National Register of Historic Places, and protect or mitigate effects to resources that are eligible (CR-2, CR-3, and CR-4).

Cultural resources are fragile and non-renewable resources that chronicle the history of people using the forested environment. They include:

- Historic properties; places that are eligible for inclusion in the National Register of Historic Places (NRHP) by virtue of their historic, archaeological, architectural, engineering, or cultural significance. Buildings, structures, sites, and non-portable objects (e.g., signs, heavy equipment) may be considered historic properties. Historic properties are subject to the NRHP's Section 106 review process;
- Traditional cultural properties (TCPs); localities that are considered significant in light of the role(s) they play in a community's historically rooted beliefs, customs, and practices may also be considered historic properties;
- American Indian sacred sites that are located on federal lands. These may or may not be historic properties; and
- Cultural uses of the natural environment (e.g., subsistence use of plants or animals) that must be considered under NEPA.

Cultural Resources Existing Condition

Previous and recently conducted cultural resource inventory survey has covered about 50.7% (10,655 acres) of the proposed approximately 21,000 acre project area. Although roughly 1800 acres of this coverage represents past surveys in high probability areas, it is counted twice because of the substantial change in surface visibility conditions after the fire. If this dual coverage were not included, previous and new surveys would account for roughly 42% (8,855 acres) of the project area having been surveyed.

Pre-Fire Conditions

Prior to the fire there were 27 cultural resource sites identified in the project area. Twenty-three of the sites have been evaluated for eligibility to the National Register of Historic Places. Eighteen of the cultural resource sites were found eligible while five were deemed not eligible. The remaining four sites have not been evaluated. Site types represent nearly the full range of sites on the district and include lithic scatters with and without flaked and

ground stone tools, rock cairns, possible pit house depressions, cambium peeled trees, and hunting blinds. Historic era sites represent early public and Forest Service administrative use. A fire lookout, a telephone line, a trail, a road, an early ranger station location, a collapsed log cabin, and historic debris scatters are examples of historic site types present in the project area.

Post-Fire Conditions

Immediate post-fire visits in early July 2003 reached 14 of the previously recorded sites. Eleven of the sites not visited are mostly within an area that received partial burning, based on observations from a distance. Non eligible sites were not visited.

As of late October 2003, all but four of the 27 sites have been visited. During post-fire survey and site visits, at least five sites were expanded due to the greater surface visibility of cultural material. Boundaries at these sites were expanded by a factor ranging from 10 to +100%. Fourteen new sites were also identified. Thirty-five sites are now identified within the fire perimeter; there are, however, several instances where clusters of formerly small sites were enlarged and merged into a single larger entity. In the first case, two smaller sites became one larger lithic scatter site with an historic component. In a second case, four formerly small lithic scatter sites were combined into one much more extensive lithic scatter with flaked and ground stone tools. In a third instance, three formerly small lithic scatter sites were combined into one entity with both flaked and ground stone tools. Altogether, six previously small sites (< two acres) have been incorporated into three larger entities (> two acres).

Cultural Resources Environmental Consequences

Under the National Historic Preservation Act, as amended, and its implementing regulations found in 36 CFR 800, "effect" means alteration to the characteristics of an historic property qualifying it for inclusion in or eligibility for the National Register of Historic Places (36 CFR 800.16 (i)). Integrity of the property's location, design, setting, materials, workmanship, feeling, or association is considered when determining site eligibility. Examples of adverse effects on historic properties include but are not limited to physical destruction, damage, or alteration of all or part of the property.

Following guidelines in our 1995 Regional Programmatic Agreement (PA) among USDA-Forest Service, the Advisory Council on Historic Preservation, and the Oregon State Historic Preservation Office, a finding of No Adverse Effect under Section 106 of the NHPA has been determined for this project. This finding is based on the knowledge that avoidance will not always be a desired option. The probability that certain eligible sites will be impacted during project activities leads to this finding of effect as described in 36CFR800.5 (Federal Register Vol. 65, No. 239; Tuesday, December 12, 2000; page 77729). Implementation of a data recovery/treatment/rehabilitation plan will mitigate the adverse effects.

The Davis Fire Recovery Project area lies outside of lands ceded for the Burns-Paiute, Klamath, or the Confederated Tribes of Warm Springs according to the Middle Oregon Treaty and the treaty boundaries as depicted in the Royce Indian Land Cessions circa 1778-1883.

Government to government consultation with the tribes has been occurring with the tribes early on in the process in the format of scoping letters and dialogue from the tribes providing feedback to the proposed activities within the Davis Fire Project analysis area. No special concerns about Tribal resources were identified. It is acknowledged that the Tribes may have lost the verbal history and they may not know where desired plant species and resources may be found. This affects their ability to tell Federal agencies where Tribal trust resources can be located on Federal lands. See page 3-323 for more discussion of culturally important plants.

Alternative A

Alternative A is the no action alternative. There would be no change in current management direction or in the level of ongoing management activities. There would be no direct effects on cultural resources because there would be no change to the integrity of eligible or potentially eligible sites. There may still be indirect effects on

cultural resource sites under this alternative. Cumulative effects are possible at certain sites within the project area because of other management activities.

Indirect Effects

The probability of a reburn is higher, to an unknown extent, in heavy fuels (Brown 2003). By not treating fuels, the risk of another wildfire event is likely increased. Further suppression, rehabilitation, and restoration efforts would place vulnerable sites at risk of additional damage from heat and fire line construction and rehabilitation. Another indirect effect would be that without reforestation or watershed improvement, sites might be at risk from erosion and flooding. The areas would eventually recover without assistance but in the meantime, the risk of loss remains.

Cumulative Effects

On-going management activities include plans for rehabilitation of developed recreation facilities. While not part of the proposed action, there is a potential for cumulative effects on cultural resources from this work because of alterations to site integrity. However, these actions would be mitigated through implementation of a cultural resources treatment plan, similar to that proposed for this project.

Alternatives B, C, D, and E

Among the remaining four alternatives, the rest of this effects analysis will be similar. Similarities and differences in the alternatives will be discussed concerning harvest versus non-harvest activities. This is followed by comments about potential direct, indirect, and cumulative effects from the proposed activities.

Alternatives B and C both have one ground-based salvage unit where an unevaluated site is present. It will be evaluated, and if found eligible, can be marked and monitored for avoidance. Alternatives B, C, and E each have three helicopter-based salvage units where up to five eligible and unevaluated sites are located. Alternative D has no harvest units that would affect any eligible or unevaluated sites.

Non-harvest activities that have the potential for effect on cultural resources are nearly the same in each action alternative. They include fuels reduction, additional fuels reduction and reforestation around the developed recreation facilities, planting along Odell Creek, planting in areas of the key elk habitat, and additional reforestation in old units where plantations had been established. Because there are eligible or unevaluated sites within these activity units, there is a potential for effect under all action alternatives, according to the NHPA definition of effect.

Alternative E proposes all of the same non-harvest activities, but not in all of the same areas. The main difference is that there will be no reforestation outside of harvest units or areas immediately adjacent to harvest units. Fuels treatments along portions of the Cascade Lake Highway are also different.

Direct Effects

There would be no direct negative effects on cultural resources from any of the action alternatives. While the proposed activities may affect characteristics of the sites, these will not be significant effects (CEQ 1508.27) because the data recovery/treatment/rehabilitation plan will mitigate them. Avoidance measures for several sites that are deemed eligible or potentially eligible to the NRHP will be implemented as per Stipulation III.B.2 (a-d) of the 1995 Programmatic Agreement mentioned earlier.

Cultural resource inventory surveys preclude examination of every proposed activity unit. During the course of project implementation, should any previously unidentified cultural resource site be discovered, there may be a direct, long term effect because the site was not discovered in advance and damage occurred in the form of lost integrity and context from churning, mixing, compaction, and displacement of soils containing cultural artifacts. Within the proposed action, the risk of this is limited because of where most of the activity units are located in

relation to known cultural resource sites. The #C6.24 clause of timber sale contracts provides for modification or cancellation of any service contract to protect cultural resources, regardless of when they are identified.

Indirect Effects

Indirect, short term effects might include continued high visibility until ground cover vegetation is reestablished and seedlings begin to drop leaves, contributing to less visibility of surface artifacts; high visibility is a leading cause of loss from illicit collection. Another indirect, long term effect might develop through increased access to formerly remote locations. Even though temporary roads developed during harvest activities are later closed, these routes remain visible and can give foot access to otherwise less accessible areas where sites are located.

Sites located on sloping ground may experience erosion and run-off of surface water, melting snow, and heavy rains from disturbed surfaces upslope, at least until the material stabilizes with new vegetation growth. While not a direct effect of harvest, fuels, or reforestation activities, the effects of temporary roads are indirectly related in that a site located down slope and outside of a harvest unit may be affected by erosion of exposed soils. This would also be considered a long term effect, because the surface visibility is altered until natural processes remove the excess sediment. Loss of covering sediments may also remove artifacts that migrate upwards in the soil through natural processes. Based on information in the hydrology section of this document, there appears to be little potential for these events because of where cultural resource sites are located relative to the steeper slopes.

Cumulative Effects

Cumulative effects are more difficult to quantify but are a result of past actions, present actions, and reasonably foreseeable future actions (i.e., the current proposed action). Past actions have impacted sites through road building, timber harvest, reforestation, facilities management, developed recreation, and general forest use by the public. Lookouts have been burned to the ground; phone lines abandoned; gate and sign posts, toilet vaults, water systems, and hardening of surfaces have affected sites; and the ever present illicit activity of "collecting arrowheads" have all contributed to the accumulated loss of integrity and information present at sites. Natural processes also contribute to cumulative effect, although they are not within our control. Erosion, weathering, and decomposition of perishable materials are examples of on-going, natural processes. Incrementally, these impacts affect site context and integrity.

Present and reasonably foreseeable future actions that may have effects on sites include continued management of roads, trails, developed recreation facilities, and plantations. These actions can all be viewed as long term effects. In an archaeological sense, they are irreversible because the resource is finite and non-renewable. Whether they are irretrievable effects, however, would depend on whether archaeologically significant information is still present, despite the impacts. Forest roads and campgrounds will not be going away unless public uses of the forest radically change. Trail and road maintenance activities sometimes impact previously undisturbed portions of sites. Native surfaced roads that are upgraded with gravel are thereafter more limited in visibility of and access to site materials. Installation of new barrier or sign posts, while minimal in volume of excavation, still tend to disturb new areas of a site. The potential for these effects is considered low because of where the cultural resource sites are located relative to the proposed action.

Recreation

Recreation Introduction

The Davis Lake area provides a range of activities for recreational opportunities. These include fishing, hiking, hunting, boating, camping, horseback riding, sightseeing, mountain biking, mushroom picking and off-highway vehicle (OHV) use. Davis Lake has two developed fee sites and provides multiple sites for dispersed recreation. The types of vegetation management activities that may affect recreation are salvage logging, slash disposal, reforestation and removal of hazard trees occurring in or near high use areas used by seasonal users. Changes in road status (either development or closure) may also affect recreational activities around Davis Lake and surrounding areas.

The majority of the activity occurs in lands designated for Intensive Recreation, and a Recreation Opportunity Spectrum (ROS) for Roaded Natural. This is characterized by a predominately natural-appearing environment with moderate evidence of the sights and sounds of humans. The remainder of the area is in Roaded Modified, characterized by a setting that is heavily modified by human activity and access is generally easy for highway vehicles.

Existing Condition/Facilities

Recreation facilities include two fee campgrounds operated under permit. Located on Davis Lake, West and East Davis campgrounds operate for approximately 160 days. West Davis can accommodate a total of 115 people at one time (PAOT) when fully occupied. East Davis can accommodate up to 165 people. Both campgrounds attract a variety of people seeking recreational opportunities; totaling 5,844 users who visited both sites in 2002. Lava Flow is also a developed campground on the eastern side of the lake and was untouched by the fire. Currently, there are no fees required for camping and it has 6 developed camp sites that are used mainly during hunting season and holidays. The remaining sites are less used, and currently there is a proposal to refurbish existing sites to accommodate campers displaced from the other side of the lake.

There are approximately 10 miles of designated trails within the project area. Trail use consists of hikers, horse back riders, snowmobile, cross country skiers and OHV use throughout out the year. The Metolius/Windigo trail is one of the designated trails affected by the fire. Approximately 3.6 miles of the trail is proposed to be relocated due to the hazardous conditions adjacent to the trail.

The level of unregulated camping with no fee (dispersed) recreation throughout the project area is considered high, especially during hunting season and holidays (Fourth of July, Labor Day, Memorial Day etc.). Dispersed areas around Davis Lake consist of approximately 20-30 sites. Frequently used sites are located on the 090, 095, and 096 spur off of the 4660 road.

There are a number of user-created OHV trails within the project area or on the adjacent private lands. Due to the severity of the fire and resulting reduction of natural barriers, there is a concern about increased use of OHVs and the potential resource damage. Unmanaged recreation, particularly undesirable impacts from OHVs has been identified by the Forest Service as a key threat to the Nation's Forests. It is therefore a national emphasis item for the Forest Service. Policy development is currently focusing on moving to a general prohibition on cross-country travel by OHVs (www.fs.fed.us/recreation/programs/ohv).

Within the project area, a closure order is now in effect restricting motorized use.

Recreational mushroom collecting is expected to increase as a result of the fire. The District has prepared for a morel season for 2004 by devising a permit system allowing only limited entry along major roads for public safety and to limit the potential for introduction of noxious weeds. Motor vehicle travel and parking will not be allowed off the road system. Buying stations will be limited to private lands near Crescent Lake Junction. Camping will not be allowed within the fire perimeter and if sanitation or public safety is determined to be potentially affected, designated camping would be enforced

Special Uses

An annual operating plan provides management direction for the two campgrounds (East and West Davis) under recreation special uses permit. There are no non-recreation special use permits in the project area.

Permits are required for the gathering of special forest products, which include firewood, cones, mushrooms, transplants, rocks/minerals and post and poles.

Effects of the Davis Fire

The landscape and the recreational experience have changed and the area would not likely meet visitors expectations for at least the next five years until vegetation returns. Many of the dispersed campsites were burned over by high intensity fire. Most live vegetation that provides shade and screening from the view of adjacent sites has been removed by the fire.

The fire completely burned West Davis and partially burned East Davis developed campgrounds. West Davis campground sustained significant damage including 18 of 22 picnic tables; campsite markers w/numbers; informational signs, 2 bulletin boards, 1000 treated barrier posts, 500 linear feet of barrier logs and two recently installed toilet facilities. East Davis Campground lost one quarter to one half of the sites. Items that were destroyed consisted of approximately 4 of 33 picnic tables, informational signs**,** campsite markers w/numbers**,** 101 treated barrier posts, and 100 linear feet of barrier logs.

Although much of the area would no longer meet visitor's expectations, use levels around the lake are expected to remain the same. Visitors may shift their use to other places, as well as their type of recreation.

Hazard trees in developed sites and along major roads have been felled and removed. Spading of conifers and planting of seedlings is planned to begin in the spring. Due to concerns for sensitive resources located along the 600 road (Odell Creek), dispersed camping has been discouraged in the past through placement of boulders. Now that the area is exposed and natural barriers are no longer present, dispersed use along the Creek would be more difficult to prevent.

Although the Lava Flow Campground is the only developed site on Davis Lake that did not burn, the south entrance along the 850 spur sustained some mortality. The area affected was approximately one half mile on the lake side and one mile on the east side of the road. The fire did not reach the first camping area, the boat launch, or the restroom structures. It is considered a priority to reduce the risk to loss from future wildfire to this campground and the remaining adjacent late successional forested habitat. Measures such as installation of metal fire rings would be in place by the 2004 season to anticipate the shift in use and the subsequent additional source of ignition for another wildfire.

Recreation Environmental Consequences

Alternative A - No Action and Alternative D

Direct and Indirect Effects

Under the No Action Alternative there would be no change to the recreational opportunities that exist post fire. Custodial management such as hazard tree removal along roads and in developed campgrounds and fire suppression would continue.

The assumption is that the entire area would be open to the public within a year regardless of the alternative selected.

Access to the area would remain at its current levels, especially along the 600 spur to East Davis Campground when not blocked by fallen trees. Also, the visiting public would have an elevated level of risk of hazards from falling dead trees, especially adjacent to the developed sites. The Cascade Lakes Highway, as well as access provided by alternate road systems, could be closed for several days at a time from windfall.

Also, due to loss of natural barriers and unrestricted access, inappropriate OHV use is expected regardless of the alternative selected.

Dispersed camping areas would remain at their current number of sites, although some would be more desirable than others.

Alternative D is similar to "No Action" as there would be no active management in the Late Successional Reserve surrounding Davis Lake. Approximately 1,450 acres of small diameter non-commercial fuels reduction would occur surrounding the developed sites and along Cascade Lakes Highway, but it is assumed most of this work would be performed by hand or low impact methods. Approximately 1,045 of commercial harvest would occur on the east aspect of Davis Mountain and its flanks, but it would not be evident to most visitors at Davis Lake. A mitigation measure was designed to orient skyline corridors away from areas that can be seen, blending contrast with surrounding landscape. Dependent upon the seasonality of implementation, harvest activities would be noticeable to visitors at Wickiup Reservoir, as they would be able to see and potentially hear harvest operations. Due to the position on the mountain of the units, it is expected to be subordinate to the usual and accustomed setting at Wickiup Reservoir. This impact would be of short duration (2-3 years during summertime months). Mitigation measures to limit the hours of operation would be utilized if the season of operation overlaps with the summer recreation.

Cumulative Effects

The recreation setting around Davis Lake has changed due to the fire. West Davis Lake Campground will likely not be available for overnight camping in the near future. Improvements at Lava Flow Campground (e.g. installing new toilets implementing new fees) are being planned with the intention to provide this use in an alternate area of Davis Lake.

All Action Alternatives

All action alternatives include a closure and decommission of road 600 that leads to the East Davis campground. Access to the campground remains, but approximately 6 dispersed sites along Odell Creek would no longer be accessible by vehicle.

Alternatives B, C, and E

Direct and Indirect

These alternatives would likely be most noticeable and affect those who recreate during the primary visitor season during summer months. Dependent upon the timing, if one of these alternatives were selected, dust and noise from harvest equipment would be evident to the casual visitor, especially around the Davis Lake area where recreation is the greatest. Evidence of harvest operations would be noticeable for up to three summers, once implementation begins. A mitigation measure was developed that would limit the hours of operation and it is expected to allow visitors some periods of solitude and remoteness.

For those who enjoy wandering outside of the developed setting, hazards that would otherwise be present from falling snags in the next decade, hazards from falling trees would still be present, but to a lesser degree.

From a visual and "sense of place" perspective, the greatest effect to this resource was the wildfire itself and the loss of vegetation and remaining dead trees. It is expected most forest visitors would also notice evidence from soil disturbance and tops and limbs (slash) from harvest activities, especially adjacent to Cascade Lakes Highway. Alternatives were designed to utilize advanced harvest systems to minimize the effect to these resources. Alternatives C and E would respond the best by utilizing helicopters to a greater extent than Alternative B, which would have the most effect on soil disturbance and contrast. About 3-5 years following harvest operations, return of vegetation and disposal of slash would diminish the evidence of harvest operations. Although consistent with the Recreation Opportunity Spectrum for the area, more restrictive visual standards along Cascade Lakes Highway is the basis for a Forest Plan Amendment to allow harvest activities to be noticeable. Reference the scenery report for more details regarding visual quality.

Forest visitors may also notice limited access caused by harvest operations. For safety, many lesser roads could be temporarily closed for up to one year at a time while harvest operations are being implemented. Main access around Davis Lake may also be temporarily closed during logging operations. Alternate access during the summertime months would be provided and flaggers may be present, causing a delay for some in reaching their destination. These potential delays could last for up to 30 minutes on main roads and from one to two summers on lesser traveled routes.

Effects discussed for summertime recreation would also apply to those who recreate other times in the area, such as winter enthusiasts, hunting, fishing, and mushroom harvest seasons.

Cumulative Effects

Approximately 260 miles of roaded access would remain open as part of the long term management plan described in the Davis Roads Analysis. This reduction would likely have no measurable effect to those who drive for pleasure or need to access favorite places except in one circumstance. Road 600 to East Davis campground contains a network of user-created roads that traverse along the edge of Odell Creek and this road is proposed for closure, including 4660-410, 4660-415, 4660-412 4660-600, 4660-615, 4669-100, 4669-010 and 4669-070. Approximately 6 unrestricted camping sites with no fees (dispersed) are located along this road and access would no longer be provided. In context to the entire Davis Lake area that currently contains about 20-30 of these dispersed sites, this reduction would potentially displace campers. Some, who may be unaware of the proposals, would likely move to other suitable areas around the shoreline of Davis Lake, Wickiup, or Crane Prairie Reservoirs where vegetation remains and similar opportunities are available.

Unroaded Areas

Introduction

Unroaded areas are defined in the FEIS for the Roadless Area Conservation Final Rule as "any area, without the presence of a classified road, of a size and configuration sufficient to protect the inherent characteristics associated with its roadless condition. Unroaded areas do not overlap with the inventoried roadless areas." (USFS 2000, page G-12). Unroaded areas have typically not been inventoried and are, therefore, separate from inventoried roadless areas. This document uses the term "unroaded area" to differentiate these areas from inventoried roadless areas. There is no Inventoried Roadless Area (IRA) within the Davis Fire Recovery Project. The nearest IRA is the Maiden Peak Roadless Area approximately 1.2 miles to the west of the western edge of the Davis Fire. There are no Forest-wide or Management Area standards specific to unroaded areas in the Deschutes Forest Plan.

Affected Environment

The Oregon Natural Resources Council (ONRC) submitted a map on December 19, 2003 that displayed two unroaded areas within the vicinity of the Davis Fire Recovery Project. ONRC requested that the Forest Service consider the impacts to the values that unroaded areas may have before logging. ONRC also stated that the Forest Service should avoid salvage logging and road building in these areas. The areas are unnamed on the ONRC map, and no acreages were provided. Estimates for the size of the areas were made by approximating the location and digitizing in Arcview.

One of the areas on the ONRC map is a lava flow that dams Davis Lake. This area is not contiguous with an Inventoried Roadless Area. The Deschutes Forest Plan allocates this lava flow to Bald Eagle, Scenic Views, and General Forest Management Areas. The Northwest Forest Plan allocates this area to Matrix primarily, with minor amounts of Administratively Withdrawn and Late Successional Reserve. This unroaded area is outside the Davis project area, and no activities are proposed within it. Except on the lake edge, roads border all sides of the lava flow, which measures approximately 1,300 acres. Some areas along the flanks of the lava flow are used by off-highway vehicle enthusiasts. A gravel pit, not currently in use, is located in NE ½, SW ¼ Section 30 inside the flow; the access road is not currently open. Dispersed camping sites are located at the north end and on the west side where the lava meets the lake. A developed campground is located at the southern tip of the lava flow (see Map #4).

The other area mapped by ONRC is located on the upper 1/3 of Davis Mountain. This area is approximately 1,500 acres in size and is partially incised by roads. This area is not contiguous with an Inventoried Roadless Area. The Deschutes Forest Plan allocates this area to Scenic Views and General Forest Management Areas. The Northwest Forest Plan allocates this area to Late Successional Reserve. Other buttes around Davis Mountain are similar in elevation, form, and vegetation (e.g. Hamner Butte, Royce Mountain, and Odell Butte). A fire lookout was located at the top of Davis Mountain until it was disassembled and destroyed by fire in 1969. The fire lookout is now located on Odell Butte. There is a road to the top of Davis Mountain, coming up the south side. Early (1915 and 1933) National Forest recreation maps of the area show a trail accessing the top of the mountain from the north side. This trail is not shown on current maps.

The ONRC did not specify any particular values related to roadless character that they believe these areas provide. The effects discussion focuses on the values that may be provided by unroaded areas, including the following:

- Natural appearing landscapes for dispersed unroaded recreation opportunities such as hiking, camping, wildlife viewing, hunting, and cross-country skiing, and the solitude they can provide.
- Protection of cultural and heritage resources.
- High quality or undisturbed soil, water, and air; sources of public drinking water.
- Habitat for abundant and healthy fish and wildlife populations.

- Diversity of plant and animal communities, including areas that are relatively at less risk from noxious weeds.
- Habitat for threatened, endangered, and sensitive species.

Environmental Consequences

Direct and Indirect Effects

Alternative A

There would be no direct effects from the No Action alternative on either of the unroaded areas. No activities would take place that would have any direct effect on the roadless character of the areas.

Alternatives B, C, D, and E

There would be no direct or indirect effects from the action alternatives to the lava flow unroaded area. No activities from the action alternatives would take place in that area.

The following project units overlap the unroaded area atop Davis Mountain: 215, 235, 240, 270, 375, and 376. Units 375 and 376 are proposed for small-diameter fuels treatments only. The other units are proposed for salvage logging.

With Alternative B, temporary road construction may be required to fully access unit 270, at the eastern edge of this unroaded area. Unit 270 is helicopter logged under Alternative C, D, and E, and there would be no temporary or permanent road construction within the unroaded area atop Davis Mountain.

Road proposals were developed through the Roads Analysis process. The transportation system in the project area was reviewed and evaluated by an interdisciplinary team. The analysis process is documented in the Davis Fire Area Roads Analysis Report (USFS 2003(b)).

Undisturbed or High Quality Soils, Water, Air There are no water resources on Davis Mountain. Impacts to soils where units overlap the unroaded area are expected to be negligible. Appendix B lists unit 270 as within the Forest Plan guidelines for detrimental soil disturbance.

Habitat for Fish and Wildlife/Diversity of Plant and Animals There are no fish-bearing water bodies on Davis mountain. The effects to wildlife habitat are discussed in the wildlife section, pages 3-178 to 3-248. Because of the high intensity fire, the area no longer provides habitat for threatened, endangered, or sensitive species. No Sensitive plants or their habitat are located on Davis Mountain.

Protection of Cultural and Heritage Resources There would be no direct or indirect impacts to cultural resources in the Davis Mountain unroaded area. The fire lookout was constructed in 1933, and then destroyed by fire in 1969. Some debris remains at the site, but it has been determined to not be eligible for the National Register of Historic Places.

Natural Appearance and Recreation Opportunities The Odell Watershed Analysis places Davis Mountain in the Central Conifer Association Landscape Area. It discusses the recreation experience as one experienced from a distance, as a scenic feature on the landscape (p 133). Scenic quality of the butte has been modified in the past by timber harvest, and most recently by the Davis Fire.

No dispersed recreation sites or trails exist on the mountain. Project activities would have a short-term impact on any hunting, hiking, or exploring that may take place; less with Alternative D than the other three action alternatives.

Around the fringes of the unroaded area, salvage logging would be evidenced by stumps, and by the sights and sounds of the activities during operations. Fuels reduction on the north side of Davis Mountain would be evidenced by burnt slash piles.

Noxious Weeds The risk of noxious weeds invading these areas is limited to the area of disturbance. Mitigation measures listed in Chapter 2 are expected to be effective in limiting the introduction and spread of noxious weeds in the project area. Effects are as described under the Noxious Weed heading, page 3-326.

Natural Recovery Most of the unroaded area atop Davis Mountain will not receive any salvage logging, conifer planting, or fuels reduction.

Cumulative Effects

A previous decision has authorized work on the north end of the lava flow to eliminate user-created roads and move dispersed campsites above the high water mark. This work has not occurred yet, but is expected to be implemented within the next few years, depending on funding. In addition, work is being planned for the Lava Flow Campground that would improve campsites and replace toilets. These actions are intended to improve conditions for recreationists and improve water quality. This may result in more people visiting this campground who may find the lava flow an interesting place to explore on foot. The Davis Fire Recovery Project would have no further cumulative impacts to the lava flow area.

Road building, past harvest, and the Davis Fire have impacted the natural appearance of Davis Mountain. It also was once the site of a fire lookout. The top of the mountain experienced low, moderate, and high intensity fire. Salvage logging will take place only in high or moderate intensity, where there is complete mortality, around the edge of the unroaded area. The pockets of low severity will still have green trees, and consequently more cover than the surrounding areas that burned at a higher intensity. This may provide a sense of solitude, but that would be impacted in the short term by the surrounding salvage and fuels reduction activities.

Future fire suppression on Davis Mountain would be expected in the event of a wildfire. Alternatives A and D do not include any salvage around the unroaded area. Small diameter fuels reduction would take place, though, in units 375 and 276. Under those alternatives, a wildfire may be more difficult to suppress and has more risk of reaching the areas that did not burn intensely in the Davis Fire of 2003, than Alternatives B, C, and E where salvage logging would reduce fuel levels more.

The situation is very similar on Hamner Butte, where the unroaded upper elevations reach approximately 1,000 acres. Fuels reduction units and one salvage unit partially overlap the area that is unroaded. Unlike Davis Mtn., however, there was no lookout at the top and appears that there has been no road or trail leading to the peak of the butte. The effects of the project in this location are similar to those described for Davis Mountain.

Based on recommendations of the Roads Analysis (USFS 2003b) reasonably foreseeable future management of the transportation system includes road closures and obliteration, and re-opening of some roads, resulting in a net decrease of 33 miles of road. Roads to be closed around the unroaded area may increase the degree of "roadless character" on a local level. Davis Mountain will see a net reduction in open roads. Roads 6245200, 6245400, and 6245500, which border the unroaded area on the ONRC map, will be closed following project activities under all action alternatives. They will remain in the transportation system, however.

Scenery Resources

Scenic Quality Introduction

"Scenic attractiveness is the primary indicator of the intrinsic scenic beauty of a landscape and the positive responses it evokes in people. It helps determine landscapes that are important for scenic beauty, based on commonly held perceptions of the beauty of landform, vegetation pattern, composition, surface water characteristics, land use patterns, and cultural features" (*Landscape Aesthetics: A handbook for Scenery Management,* USDA, 1995*)*. Scenic attractiveness is ordinarily very stable. However, in rare circumstances, scenic attractiveness may change because of natural disasters or human alteration of the landscape. Change may increase the potential for a "typical or common" landscape to become "distinctive" (*Scenery Management System Handbook,* USDA, 1995). Along the Cascade Lakes Highway (Highway 46), natural disturbances such as past wildfires, insect and disease infestation, and wind damage are evident. As a result of the Davis Fire, the area is characterized by a mosaic of burned forest conditions, ranging from unburned or low intensity fire along the fire perimeter where it crosses the Cascade Lakes Highway, to stand replacement in the Davis Lake Basin and between Hamner Butte and Davis Mountain.

The Davis Lake area has a history of being unique as designated for special management to "preserve and provide interpretation of unique geological and cultural areas for education, scientific, and public enjoyment purposes" (Forest Plan, 4-90). Before the fire, the area provided recreation opportunities to generations of people who have recognized its truly unique ecological quality and diversity of landscape.

Management Direction

The following are standards and guidelines from the 1990 Deschutes National Forest Land and Resource Management Plan as amended by the 1994 Northwest Forest Plan. The Standards and Guidelines for the Northwest Forest Plan shall take precedence except in cases where the Deschutes National Forest Plan is more restrictive or provides greater benefits to Late-Successional forest-related species (1994 ROD, page 8).

The Forest Service implementing regulations establish a variety of Scenic Quality Standards for scenic views. These include:

1. Retention (Natural-appearing landscape with high scenic integrity level);
2. Partial Retention (Slightly altered landscape with medium scenic integrity level);
3. Modification (Altered landscape with low scenic integrity level within the foreground as well as in the middleground landscape).

For the purposes of this analysis, the existing Forest Plan direction on scenic quality will be used. However, whenever possible, Scenic Integrity Objectives will also be displayed and discussed. Further direction regarding scenery management is found in Forest Service Manual 2380 (Landscape Management).

The Deschutes National Forest Plan allocates approximately 40% of the project area to Scenic Views (8,272 acres). Also, the Scenic Views management allocation overlaps Bald Eagle Management Areas. There are two zones that fall within the project area as viewed by the visitor. Along the travel corridors, trails, and developed recreation sites, foreground landscape extends one half mile on either side. The middle-ground landscape is the zone extending up to 5 miles beyond one half mile.

The following table specifies the management allocation for scenic views within the Davis Fire:

Retention Foreground (SV-1)	404 acres
Partial Retention Foreground (SV-2)	4 acres
Retention Middleground (SV-3)	4 acres
Partial Retention Middleground (SV-4)	7,860 acres

Table 3.128 Scenery Allocations for the Project Area

SV-2 and SV-3 scenic view designations will not be affected by any alternatives; therefore, discussions will focus on SV-1 and SV-4.

Existing Condition of Scenic Quality

Landscape Character – Pre-fire Condition

The Davis Fire Recovery Project is characterized by flat topography surrounding Davis Lake transitioning from gentle slopes along the Cascade Lakes Highway to steeper gradients near Hamner Butte and Davis Mountain. Elevations range from 4300 to 7100 feet above sea level. Precipitation primarily occurs in the form of snow in the wintertime, and the amounts are highly variable dependent upon the closeness to the Cascade Mountain Range. The Landscape is dominated on the eastern side by two stratovolcanoes and on the western side by lodgepole flat and lava flows surrounding Davis Lake. Two perennial streams are within the fire perimeter and drain into Davis Lake. Adjacent to the Cascade Lakes Highway towards Hamner Butte and Davis Mountain are primarily mixed conifer stands containing large trees and a wide variety of species (lodgepole, western hemlock, Shasta fir, Douglas-fir, ponderosa pine, western white pine, sugar pine, and white fir). Major travel ways are Hwy 46, Forest Roads 44, 62, and 4660 which provides access for the public into the Davis Fire area and the popular Cascade Lakes recreation area. These access roads are the primary access into and out of the numerous recreation sites, including developed campgrounds, Davis Lake, and other destinations that make this area special.

Landscape features include lava flows, cinder buttes, and water bodies in the form of a natural lake and perennial streams. The project area contains strong line, form, color, and texture (components used to measure scenery). Also, an important component of the scenery is a diversity of large Douglas-fir, sugar, western white, and ponderosa pine trees lining the roadway. Along most of the route within the fire area, there are limited views beyond the foreground. A scenic overlook near milepost 9.6, where trees were strategically thinned, provides views of the peaks to the west across the lodgepole basin.

The Cascade Lakes National Scenic Byway (Hwy 46) bisects the fire area for 4.6 miles and some of the corridor is classified as full retention (High Scenic Integrity Level) on the foreground views. Although the rest of the corridor is allocated to bald eagle management, the entire corridor would be considered for scenic views (retention) regardless. Scenic Views Middleground is viewed on and between the slopes of Davis Mountain and Hamner Butte. The following are locations where Middleground can be viewed:

- Northeast side of Davis Mountain briefly from U.S. Highway at milepost 179
- South and Southwest side Hamner Highway near the junction of County road 61 and Highway 46
- Western facing slopes surrounding the Davis Lake area and developed sites
- North/Northeastern slope of Davis Mountain from Highway 46 and surrounding Wickiup Reservoir and developed campgrounds.

Landscape Character - Post-fire Condition

The area's landscape character, scenic quality, and scenic integrity level remains unchanged. Overall, scenic quality has been altered by the Davis Fire. Scenery management objectives direct management of landscapes to

assess deviation of scenic quality on post-fire landscapes, rather than from pre-fire scenery. This differs from *scenic integrity* ratings which would rate the area low to moderate from a cultural and biological perspective.

Along the 4.6 mile stretch of the Cascade Lakes Highway, the views are more open where mortality was classified as mostly moderate to high. In some pockets on either end of the fire perimeter, the fire burned less intense, creating various mosaic patterns within a forest of mixed tree species. Although this fire may visually appear "natural" to some forest visitors, many perceive the landscape no longer contains the components of a healthy landscape. Landscapes are primarily viewed by two types of constituents: casual forest visitors who mainly are from outside the central Oregon area, and local residents who tend to be more familiar with forest succession and processes. These two groups may view the post-fire landscape differently.

The fire intensity within the Partial Retention Middleground (Hamner Butte, Davis Mountain) designation was mostly high where tree mortality is 100%. The vegetation will appear blackened across much of the area for many years, although new grasses and herbaceous material began to emerge in the fall season of last year.

The wildfire created a landscape characterized as unique (Forest Service Manual 2380, Landscape Management). In areas where stand replacement occurred, the fire has created numerous views and vistas toward distance landscapes, including "filtered views" and "open vistas" toward distant buttes, Davis Lake, and its grassy meadows. Although wildfires create openings, they also tend to highlight road building and other evidence of humans that can transform the visitor's encounter to less of a "high quality experience."

Although not classified within a scenic views management area, the area surrounding the two developed campgrounds has a Recreation Opportunity Spectrum of "Roaded Natural," and a corresponding scenery component of Modification. This classification results from the felling of hazard trees within the perimeter of the developed site.

Recently in Central Oregon, large wildfires and other forest disturbance processes are especially visible and accessible to the forest visitor along major travel corridors. These include the Davis Fire along Highway 46, Road 18 and Bessie Butte Fires along Highway 97, Skeleton Fire on Highway 20 and Awbrey Hall Fire on Highway 46 near Bend, B and B and Cache Mountain and Link Fires along Hwy 20, and , prior to the wildfires of last year, insect infestation with associated tree mortality on Santiam Pass along Highway 20. These events tend to change the landscape character to "distinctive", altering scenery to a degree that is perceived by many to be deviated from the landscape constituents valued for their aesthetic quality (i.e., it no longer appears as natural, or whole).

Scenic Quality Environmental Consequences

Direct and Indirect Effects

Alternative A: No Action Alternative

Under this alternative, nothing within the entire fire perimeter (21,000 acres), including 8,423 acres (40%) within scenic views allocation, would be actively managed. Evidence of human activity would not be apparent, except around the developed campsites and travelways where hazard trees have been felled. The successional processes, such as insects, diseases, lateral and vertical fuels build up, would continue without intervention.

Scenic Views: Retention Foreground and Partial Retention Middleground

No harvest or reforestation activities would occur and vegetative recovery would take place at a slower rate than if planted. This is due to a lack of seed source over large areas where successful natural regeneration would be delayed within moderate to intensively burned areas. It may be several decades before sapling/pole size trees exist. Achievement of the long term desired condition for Scenic Views (i.e., high quality scenery the represents the character of central Oregon forests) would be delayed several decades. In the event of a wind storm, blow down of the standing dead trees could fall at an accelerated rate and it could lead to large areas of stacked trees

on the forest floor and possibly the roadway. For the first decade, the National Scenic Byway and access to the Cascade Lakes area could be closed for several days after wind events[7]. Also, there would be an elevated risk to visitors from falling trees.

There would be no benefit to the "Roaded Natural" character surrounding the developed campsites from road and spur closures (such as the 4660600) under this alternative.

This alternative would be consistent with current Standards and Guidelines specified in the Forest Plan, although achievement of desired scenery components would be delayed for several decades.

Alternative B

Under implementation of this alternative, approximately 48% of the area allocated to Scenic Views (324 acres) would be commercially harvested using prescriptions for ground-based and advanced harvest systems.

Scenic Views: Retention Foreground

In the foreground landscape surrounding Highway 46 (404 acres), ground-based systems would mostly stay on compacted areas such as roads and existing skid trails to minimize soil displacement and contrast. In the areas where views are towards Davis Lake, advanced systems such as helicopters would further minimize soil contrast. Patches of standing dead trees would be clumped and retained over 15% of the area within treatment units. All activity generated slash that cannot be yarded or flown to landings would be piled by hand and either utilized or burned. Human activity (activity slash, and cut stumps) for up to 300 feet would not be subordinate to the landscape and would be evident to the casual forest visitor for approximately 5 years. Mitigation measures and alternative design elements such as cutting stumps low to the ground, marking trees designated for retention, removal of flagging, and handpiling of activity slash along Highway 46 are expected to be effective in minimizing the evidence of forest management. Although these activities are expected to benefit the long-term objectives for scenery management, in the short term, they would not be consistent with current Forest Plan Standards and Guidelines for Scenic Views within ponderosa pine Retention Foreground (M9-4). Forest residue would be visible to the casual visitor for greater than one year as it is likely the labor-intensive handpiling could not be accomplished in one year. The proposed Forest Plan amendment for scenic views would allow for this change.

Where areas are proposed for only small diameter thinning of trees along Highway 46, it is expected to enhance the scenery by highlighting large trees while offering filtered views to distant peaks. These activities are expected to be consistent with Retention standards and guidelines as they may not be evident to the casual forest visitor and would remain subordinate to the landscape.

Scenic Views: Partial Retention Middleground

Within this area, approximately 3,724 acres are proposed for treatment by ground-based and advanced systems on the most visible aspects of the slope. Visual effects associated with helicopter systems (1,770 acres) are expected to deviate from surrounding textural elements, although it would be noticeable, it would not be considered dominate in contrast to adjacent areas where no salvage is planned. Skyline-based harvest systems (800 acres), or specifically skyline corridors, have the potential to be the most visible (and not subordinate to the landscape) from the Davis Lake and Wickiup Reservoir area due to altered landscape textural elements as well as soil contrast. This effect is expected to last for approximately 5 years until dead trees begin to fall and revegetation begins to be visible. A mitigation measure to orient skyline corridors away from viewing areas to make them less obvious has been utilized on the forest in past skyline operations and has proven to be effective. In five years or less, once snags begin to fall and a regenerated forest is established, these areas are expected to become subordinate to the landscape. These activities are expected to benefit the long-term objectives for scenery management and they would be consistent with Forest Plan standards and guidelines for Scenic Views in mixed conifer Partial Retention (M9-20).

[7] Personal conversation with Ken Kittrell, USFS Transportation Planner, 2004

Under implementation of this alternative, the desired future condition would be achieved much sooner (40-50 years) than under Alternatives A and D. As a result of planned activities, expanded views into Middleground landscape would be opened up to show distance buttes, rock outcroppings, and other geographical landmarks.

Alternative C

Direct and Indirect Effects

Although this alternative is similar to Alternative B in active management within the wildfire perimeter (6,355) acres, it differs in response to concerns for soil productivity. This alternative emphasizes advanced harvest systems which tend to lessen soil contrast and minimizes evidence of human activity. All other mitigation measures for minimizing visible human presence, access management, small diameter thinning and riparian planting along Odell Creek are the same as in Alternative B.

Scenic Views: Retention Foreground

Treatment area and harvest method within the Foreground area are identical to Alternative B, therefore the effects discussed are the same.

Scenic Views: Partial Retention Middleground

Within the Partial Retention Middleground landscape (treatment acres 3,724), the potential for visible skyline corridors which have been identified as being the most noticeable of the advanced systems in Middleground landscapes, would be reduced to 190 acres. Units that would utilize this method are located on the northwestern mid slope of Hamner Butte and although visible from Davis Lake, corridors could be oriented where the contrast would be much less visible than in Alternative B which utilizes 800 acres of skyline on both Hamner and Davis Mountain. All other effects as discussed for Alternative B are similar.

Alternative D

Direct and Indirect Effects

Under implementation of this alternative, approximately 1,045 acres of salvage would occur in lands outside of the Late Successional Reserve, mostly on the eastern slope of Davis Mountain. This alternative would utilize 850 acres of ground-based and 195 acres of skyline systems. All other management activities considered beneficial to scenery, such as access management, small diameter thinning and riparian planting along Odell Creek are included in the design of this alternative.

Scenic Views: Retention Foreground

Within Retention Foreground scenery along Highway 46, no active management would occur except the felling of hazard trees along the route. No planting of conifers would occur in this zone and natural regeneration would be the method for reforestation. This alternative would be consistent with current Forest Plan Standards and Guidelines for scenery within Retention. Effects discussed for Alternative A (Retention Foreground) scenery would be similar for this alternative.

Scenic Views: Partial Retention Middleground

Within Partial Retention Middleground (502 salvage acres), approximately 195 acres of skyline systems are proposed on the eastern slope of Davis Mountain. Skyline corridors have the potential to be viewed from Wickiup Reservoir. As in Alternatives B and C, a mitigation measure designed to orient the corridors away from the reservoir would lessen the contrasting features. This alternative is consistent with the current Forest Plan Standards and Guidelines for Scenic Views in mixed conifer Partial Retention.

In the long term, achievement of objectives for scenery management would be considered delayed (similar to Alternative A) due to the small scale of active management, and distance from where most forest visitors travel.

Alternative E

Under implementation of this alternative, an estimate of approximately 3,290 acres would be harvested using aerial logging systems (helicopter). Planting of conifer trees, access management, and riparian planting along Odell Creek would also occur.

Scenic Views: Retention Foreground

This alternative proposes 404 acres of treatment within this area. Of the three alternatives that propose active management within this zone, this one would have the least visual impact due to the use of helicopters which are expected to minimize soil contrast and evidence of human activity. Although these activities are expected to benefit the long-term objectives for scenery management, in the short term, they would not be consistent with current Forest Plan Standards and Guidelines for Scenic Views within ponderosa pine Retention Foreground (M9-4). The proposed Forest Plan amendment for scenic views would allow for a short term change to visibility.

Scenic Views: Partial Retention Middleground

Within this area, approximately 2,864 acres would be harvested using helicopters. Similar to within the Retention zone, of the active management alternatives, this one has the least change to textural and color elements of scenery. All other effects discussed in Alternative B are similar.

Simulation of Salvage and Fuels Reduction Activities

Based on the number of snags to be left per acre, the following two pictures present "before" and "after" treatment views of a typical mixed conifer stand.

Before

After

National Scenic Byways Program

The National Scenic Byways Program is part of the U.S. Department of Transportation, Federal Highway Administration. The program is a grass-roots collaborative effort established to help recognize, preserve and enhance selected roads throughout the United States. Since 1992, the National Scenic Byways Program has provided funding for almost 1,500 state and nationally designated byway projects in 48 states. The U.S. Secretary of Transportation recognizes certain roads as All-American Roads or National Scenic Byways based on one or more archaeological, cultural, historic, natural, recreational, and scenic qualities.

The Cascade Lakes National Scenic Byway (46) is part of this system and relies on Scenic Views allocation in the Deschutes National Forest Land and Resource Management Plan to maintain scenic views for travelers. The scenic byway program focuses on long-term scenery management (Gyorgyfalvy, pers. Comm.). The wildfire is considered to have altered the desired scenery typical of Central Oregon landscapes. Although all Alternatives

would be consistent with the National Scenic Byway program, Alternatives B, C, and D would accelerate vegetation to a desired condition that existed prior to the wildfire.

Economic and Social Analysis

Economic and Social Analysis Introduction

Feedback from the public scoping process echoed the changing economy and social attitudes of Central Oregon. Differences in public opinion over how to achieve the two primary purposes of Davis Fire Salvage Project: 1.) restoring and protecting future habitat while 2.) recovering economic value from the damaged timber to help sustain local economies were clearly expressed in the public scoping which involved public meetings, tours and written communications.

A spectrum of land management actions distilled from these changing economic and social conditions were designed to meet the differing values, exemplified by these two that came from the public scoping process:

"*The need for quick and careful commercial logging seems very apparent*." Marva Beesley, LaPine, Oregon

"*Natural re-seeding of the area would happen over time-just not on a timber industry/Forest Service preferred timeline*." Karen Coulter, Fossil, Oregon

Thus the utilization of timber burned and damaged in the fire is counterbalanced by environmental concerns about proposals to speed up habitat recovery and protection from future fires.

Economic impact analysis of the activities proposed in the Davis Fire Salvage project focuses on the makeup of the communities of Central Oregon, a comparison of recent local work and unemployment data to the state of Oregon as a whole, and a discussion of economic trends by industry.

Social factors important to Central Oregon, and specifically to land and forest management as a source of local income include: the region's rural setting and its history of farming and ranching; the manner in which the local population utilizes resources for recreation; the collection of wood for fuel, fish and game for sport; and the effect of an increasing population on the region's job market and economy.

Economic and Social Analysis Existing Condition

Demographics

Five Central and South Central Oregon counties; Klamath, Lake, Jefferson, Crook, and Deschutes Counties, are considered in this analysis. The Davis Fire Salvage area is located within Deschutes and Klamath Counties. The total population for the five county area during the 2000 Census totaled 224,763. Populations and change for the region and by each individual county are displayed in the table below.

Table 3.129 Central Oregon Population Growth

County	Population		Change	Percent
	1990 Census Data	2000 Census Data		
Jefferson Co.	13,676	19,009	5,333	39%
Deschutes Co.	74,958	115,367	40,409	53.9%
Crook Co.	14,111	19,182	5,071	35.9%
Klamath Co.	57,702	63,755	6,053	10.5%
Lake Co.	7,176	7,422	245	3.3%
Central and South Central Oregon	167,672	224,735	57,063	34%

Sources: US Bureau of the Census, Vital Records, Oregon Health Division

The major population centers within the area are: Klamath Falls (19,462), Prineville (7,356), Bend (52,029), Redmond (13,481), Madras (5,078) and La Pine (5,799). Future population projections mimic that of the past decade. Deschutes, Crook, and Jefferson Counties are expected to continue with aggressive growth where more rural counties like Lake and Klamath County will continue to lag.

As with the Nation and Oregon as a whole, the population in the Central Oregon area is becoming both older and more diverse. But there are major differences within the area. For instance, the major cities, Bend, Redmond, Prineville, Madras, had lower median ages than Oregon, in fact Prineville's, Madras's, and Redmond's median age has actually decreased since 1990. Whereas more rural counties like Northern Klamath County and unincorporated areas such as La Pine, are much older than the National or Oregon average and tend to be more retiree-heavy. Although racial diversity is increasing, with the Hispanic population increasing the fastest, Central Oregon, except for Jefferson County, is less racially diverse than Oregon as a whole. According to the 2000 census, Lake is 91% white with the Hispanic population increasing 50%; Crook is 93% white with the Hispanic population increasing 179% since the 1990 census; Deschutes is 95% white with the Hispanic population increasing 182%; and Jefferson is 69% white with the Hispanic population increasing 133%. Klamath County echoes Oregon as a whole and is 87% white with a Hispanic population increase of 66%.

The education attainment level, except for Deschutes County, within Central and South Central Oregon echoes Oregon as a whole. The percentage of population having graduated from high school ranges from lows of 47% in Crook and 44% in Jefferson Counties to highs of 56% in Deschutes and 49% in Klamath and Lake Counties. For Oregon as a whole it is 53%.

Employment

According to the 2000 Census, estimated civilian labor force is: Klamath County is 28,753, up 6% since the 1990 census, Crook 7,525, up 12% since the 1990 census, Jefferson, 8,570, up 31% since the 1990 census, and Deschutes, 57,614, up 40 % since the 1990 census, and Lake, down 4% since the 1990 census. The labor force in Oregon as a whole increased 18%. In Klamath County the largest sectors were finance, insurance real estate (5,580,), trade 5,510) and government (5,400). In Crook County the three largest sectors were wholesale trade (1,640), lumber and wood products (1510), and government (1,180). In Deschutes County the three largest sectors were Finance/Insurance/Real Estate (14,170), trade (13,080), and government (6,900). In Jefferson County the three largest sectors were government (2,460), trade (1250), and lumber and wood products (1,150). In Lake County the three largest sectors were government (940), trade (500), and lumber and wood products (290).

2003 unemployment rates in the individual counties were: Klamath 7.9%, Crook, 8.4 percent; Deschutes, 6.4 percent, Jefferson, 5.6% and Lake, 6.4%. The unemployment rate in Oregon as a whole was 7.6%.

The economies of Deschutes and Jefferson are the most robust in the Zone. In Deschutes County, although there has been an increase in the number of jobs created, the huge increase in the labor force (up 40%) has negated much of this success, at least in terms of the unemployment rate. But, due to their economic diversity, both counties' economies are expected to maintain their health. This is partially due to a diversification in the wood products industry where specialized woodworking shops focused on new home construction are playing a larger role in the industry as primary milling industries have declined. The downturn in the primary lumber industry, driven by a lack of consistent forest supplies, automation, and a changing global economy, has impacted local forest workers, whose incomes have declined because of steep competition for fewer job opportunities.

On the other hand, in Crook, Lake and Klamath Counties, with their overall low economic diversity, dominated by either one manufacturing sector industry (lumber and wood products) or limited trade sectors company (Les Schwab in Crook County), have had their economies lag behind Oregon's as a whole. Future projections call for continued slow growth and diversification in these three counties.

Table 3.130 Average Annual Wages in Central Oregon 1990 – 1999 *

Industry	1990	1999	Change	Percent Change
All Industries	$25,152	$25,516	$363	1.4%
Private Coverage	$24,089	$24,617	$527	2.2%
Agriculture, Forest and Fish	$19,630	$17,983	($1,647)	-8.4%
Construction and Mining	$29,156	$28,532	($625)	-2.1%
Manufacturing	$30,633	$30,807	174	0.6%
Lumber and Wood Products	$31,251	$31,811	560	1.8%
Other Manufacturing	$29,028	$29,547	520	1.8%
Trans., Comm., and Utilities	$33,963	$35.231	$1,267	3.7%
Wholesale and Retail Trade	$18,510	$19,415	$905	4.9%
Finance, Insurance and Real Estate	$26,286	$28,468	$2,181	8.3%
Services	$21,493	$23,264	$1,771	8.2%
Government	$30,760	$30,485	($274)	-0/9%

Sources: Oregon Covered Employment & Payrolls by County and Industry

Oregon Employment Department; US Bureau of labor Statistics

Per capita personal income in 1999, as reported by the U.S. Department of Commerce, Bureau of Economic Analysis by county were as follows: Lake $20,285, Jefferson, $18,808, Klamath $20,886, Crook, $21,168 and Deschutes, $26,077. Although the per capita income in the area is traditionally lower than Oregon's as a whole ($26,958), there has been a widening of the gap mainly due to the loss of relatively high paying jobs in the lumber and wood products industries. Deschutes County's per capita income, which is the highest in the area and close to Oregon's as a whole, is attributable to a number of factors. The first being that although Deschutes County also lost significant jobs in the wood products industry they have been replaced by other high-paying finance and real estate related jobs. In addition, the increase of high-paying "high" tech jobs and an influx of wealthy new-comers have bolstered all income measures (per capita, total personal income, and median family income) as compared to the other counties.

Although the past decade has seen a significant reduction in employment within the lumber and wood products industry, the lumber and wood products industry is still an important contributor to the local economies. In Crook County, 1,510 people were employed in the lumber and wood products industry. This accounts for 25 percent of all wage and salary employment in the county, and represents the third highest paying job in the county. In Deschutes County, 4,770 people were employed in the lumber and wood products industry. This accounts for 10 percent of all wage and salary employment, and represents the seventh highest paying job in the county. In Klamath County 3,180 people were employed in the lumber and wood products industry, accounting for 19 percent of all wage and salary employment. In Lake County, or 13 per cent of all wage and salary employment, was in the lumber and wood products industry. In Jefferson County, 1,150 people were employed in the lumber and wood products industry. This accounts for 19 percent of all wage and salary employment, and represents the third highest paying job in the county.

Agriculture plays an important role in Central Oregon. Leading crops include cattle, and forage and hays. In Jefferson and Klamath Counties there is also a substantial amount of seed and vegetable products. Total agricultural sales for each county in 2000 were as follows: Crook, $34,604,00; Deschutes, $21,855,000; Klamath, $128,806,000; Lake, $54,508,000 and Jefferson, $46,431,000. Although farm income is a very small portion of total personal income in the area, the agriculture sector's role in the local economies is substantial in all but Deschutes County.

Employment and income statistical references do not specifically track recreation and tourism as a sector. Instead recreation and tourism contributes to several sectors, transportation, services (accommodations, eating and drinking, recreation), retail trade, and even government. The Oregon Tourism Commission publishes an annual report with estimates to total travel related spending in each County. Estimates for 1999 were 20.4 million dollars in total travel spending in Crook, 414 million in Deschutes, 99.7 million in Klamath, 10.4 million in Lake and 52.9 million in Jefferson.

Estimated employments from these expenditures in industries supporting recreation and tourism are as follows:

- In Crook, 380 people, representing 6.3 percent of all wage and salary employment in the county;
- In Deschutes County, 5160 people, representing 10.5 per cent of salary employment in the county;
- In Klamath, 1930 people, representing 8.3 percent of all wage and salary employment in the county;
- In Jefferson, 1040 people, representing 16.8 percent of all wage and salary employment in the county;
- In Lake 170 people were employed, representing 7.7 per cent of all wage and salary employment in the county.

Kevin Preister prepared a report for the Forest Service and BLM in July 2000 that summarized the economic situation in Crescent and Gilchrist, the two communities closest to the Davis Fire: "The big mill in Gilchrist is the main source of employment. It used to be a family owned business and, just in the last few years, it was sold to Crown Pacific, who is said to be liquidating old growth to appease their stockholders. Ranchers and farmers are having a tough time unless they have big operations. Schools and Mid-State Electric Cooperative are now the biggest employers. As in other parts of rural Oregon, commuting to the urban zones for jobs is now the dominant economic pattern."

Within the past decade, special forest products, specifically mushroom harvests, have also played a role in the economies of these communities. Harvesters are traditionally Southeast Asian extended family groups, who migrate to the area from homes in the Sacramento valley. They traditionally camp each fall in the local area, following the mushroom harvest through the Pacific Northwest. In 2003 Matsutake mushroom permit sales from the Fremont-Winema, Deschutes, Umpqua and Willamette National Forests totaled $144,050 for 1,527 permits. This was significantly lower than the 1997 season when permit sales topped $365,000 for almost twice as many permittees.

Morels, a spring mushroom, often appear after soil disturbing activities and fires. Morels could prove to be a temporary boom for the local communities in the spring of 2004. In 1992 the wholesale trade in Oregon, Washington and Idaho generated $41 million, according to a Washington State University study. Commercial pickers can earn up to $15/pound for the distinctive fungi, and wholesale buyers can fetch three to nine times that price from gourmet restaurants, specialty shops and grocers in Europe, Asia and America. A single fire on the Payette N.F. yielded more than $3 million in 1994 with buyers purchasing $10,000 to $15,000 worth of mushrooms a day. Forest Service mycologists estimated the morel harvest was nearly as valuable as the salvaged timber.

Social

Surrounding physical and biological environments influence human social life. This is most evident in rural areas where the variety and quality of available natural resources often determine the chief means of economic livelihood and what leisure activities people are likely to pursue and, therefore, influence local preferences for the use of public lands. From a historical perspective it is evident that all of the local community's cultures were natural resource-based and to a certain degree, especially in the more rural, less populated areas, still are. Livestock, agriculture and timber were the backbone of the economic structure and as a result strongly shaped the social fabric that still defines the communities today. Since much of the surrounding land is administered by federal agencies, chiefly the Ochoco, Deschutes, Winema and Fremont National Forests and the Prineville District of the BLM, changes in federal land use policies can impact the socioeconomic and socio-cultural way of life.

One needs to keep in mind that the various communities, and the individuals within them, contain a broad spectrum of perceptions and values related to the road system and use of resources on the surrounding national forests. These same communities and individuals also have interests that span multiple geographic and political scales simultaneously.

The following descriptions portray communities only in the very most simplistic terms and do not capture the full community richness. Many of the communities (rural industrial, as defined in the Deschutes NF Forest Plan) within Central and South Central Oregon, such as Crescent and Gilchrist, are closely tied to the Forests in work, subsistence, and play, and are directly affected by what happens on the Forests. The relationship between the Forests and these communities is based in part by: logs for their harvesting, manufacturing, and transportation businesses; and catering to recreationalists and tourists drawn to the area. People from these communities also use fuelwood, fish, special forest products and game for part of their subsistence and/or recreational activities. Recreation (often roaded and/or motorized) is also an important component of the life styles for many of the people living in these communities.

Communities, such as those found along the shores of Crescent and Odell Lake, are defined by their recreation opportunities and recreation residences (rural recreation and residential, as defined in the Deschutes NF Forest Plan). Environmental and scenic amenities and nearby recreational opportunities play a major role for their existence. Local service-oriented businesses are a major economic driver in these communities. These communities don't typically depend on extraction-based activities, instead scenic amenities, and recreation opportunities have more influence, both economically and socially on these communities.

Bend (Central Oregon Urban Center, as defined in the Deschutes NF Forest Plan), is the dominant community in the zone. It has a large industrial sector with wood products playing a major role, and a large service sector based on recreation and tourism. In addition its' financial, real estate sectors, and economy as whole has increased substantially as people have moved into the area because of the amenities the surrounding area provides, much of which is associated with the national forests. It is also the major shopping and service center for most of the communities within the area. Because of its population size and density, and economic and social diversity, the health of the wood products and service sectors of the economy, along with environmental and amenity values, play an important role in defining what is important to the Bend community.

Communities such as Prineville, Redmond, and Madras from a historical perspective, better fit the "rural industrial" community described above. But with their exploding populations and diversifying economies, they are developing a more diverse set of interests more along the lines of Bend's. With the recent weakening of the economy, it is clear that these communities are still very much tied to the woods product industries both economically and culturally. Other communities within the area (e.g. Paulina, Silver Lake) can generally be defined as ranching or farming communities. These communities are closely tied to the Forests in work, subsistence, and play, and are directly affected by what happens on the Forests. These communities are linked more economically because of the need for summer forage for livestock, not timber, and to provide services for recreation and tourists. These communities generally have no manufacturing based industries and have small, undiversified economies. Like "rural industrial communities", the people who reside in these communities also use fuelwood, fish, and game for part of their subsistence and/or recreational activities.

The one over-riding demographic trend in the area is that of rapid population increase through immigration. With the general gentrification that is occurring through the area and the influx of retirees, many of who are well to do, and professionals from many specialty areas. This results in rapid economic and social change.

This gentrification is also occurring in La Pine, the largest community near the Davis Fire. La Pine was zoned for relatively small parcels in the 1970s before land use laws took hold. According to residents, it used to be that the majority of landowners were absentee, like snowbirds, and used retreat cabins for vacations. Many are semi-retired now and most commute to Bend for employment opportunities. La Pine has grown from this time of rampant land speculation, to more gradual growth. It is now the largest unincorporated area of the state with a total population ranging from 5,800 to 18,000, depending on who draws the boundaries and the season of the year. The gentrification is less evident in the small communities of Crescent and Gilchrist, near the project area.

Communication in these communities appears to be problematic, since there is no city government, local media outlets or high-density city centers. Nevertheless, informal communication is effective and relied upon. Local stores, service stations, and restaurants are gathering places, as are the schools. Many people use e-mail. Network communication is high, although the level of rumors indicates that important networks do not get connected.

Effective community leadership has been emerging in recent years, in part because of the population shift from absentee to full-time residents. Thanks to development of local Community Action Teams, with most local organizations as members, these communities now have the ability to come together twice a month and are developing multiple subcommittees to focus on local issues.

Attitudes, beliefs and values were expressed in several quotes from the La Pine community included in Kevin Preister's report:

> *"La Pine has the reputation of being a backward town, full of drug addicts and welfare people, but the contrary is true. We have a community with different values than Bend. La Pine folks come here to get away from it all, to live in semi seclusion."*
>
> *"La Pine is known as the 'black sheep' of Deschutes County. We are also known as 'South County."*
>
> *"It is surprising how much behind the scenes collaboration is going on in South County. There is tremendous support among groups dealing with social issues like domestic violence, teen pregnancy etc."*
>
> *"This area is 'Bend–centric.' Bend has the power and money…."*

Economics

Forest Service Handbooks 1909.17 and 2409.18 direct the evaluation of Economic Efficiency for proposed projects. There are many methods available to meet different objectives and compare alternatives. This document will identify the method used, costs and assumptions used, and comparison of alternatives for the Davis Fire Recovery project. The objective of this report is to compare financial efficiency among alternatives to assist the decision makers with other resource analysis to identify the desired alternative for the Davis Fire Recovery EIS.

Evaluation of efficiency is a basic type of economic and social analysis and is an integral part of the planning process. Economic efficiency is a term used to describe how well inputs are used to achieve outputs when all inputs (activities) and all outputs (including market and non-market) are identified and valued. All costs and all benefits to society are included; amounts of each output are not pre-established but are produced in amounts intended to maximize net public benefits. Financial efficiency is a comparison of estimated financial costs and revenues from the planned activities.

Uncertainty exists about evaluated quantities; to deal with this uncertainty the analysis uses the best estimates of all inputs, outputs, prices and costs. The analysis can be used to compare alternatives, not to give an absolute number for the outputs. Information of how the results would vary should strengthen the basis for choices.

Data and Analysis of Stand Treatments

Timber volume estimates from salvage harvest were made for each alternative. The volumes were estimated using stand exam data from 1993, 1995 and 1997. This data was entered into the Forest Vegetation Simulator (FVS) provided by the Forest Service. The documentation, description, instructions and software for this program are available on the internet at www.fs.fed.us/fmsc/fvs. The Forest Vegetation Simulator (FVS), at its most basic level, is a family of forest growth simulation models. Since its initial development in 1973, it has become a system of tightly linked analytical tools. These tools are based upon a growing body of scientific knowledge gleaned from decades of natural resources research founded on the Prognosis growth and yield model, which itself is based on studies measuring stand characteristics throughout the northwest and which has specific adaptations for the central Oregon area. The Fire and Fuels Extension (FFE) to FVS simulates fuel dynamics and potential fire behavior over time and can be used to simulate and predict snag fall down rates, fuel loadings and parameters affecting fire behavior and fuels accumulation and decay. This model was used to compare alternative actions in the Davis Fire area including salvaging timber, treating fuels and reforestation by planting and stand development over time.

The stand exam data available for the Davis Fire restoration was extensive, covering most of the proposed action units. There were some units for which no data was available. These included stands which had been shelterwood cut or seed tree cut in the 70s or 80s and areas treated in the most current timber sales from the Seven Buttes EA. These areas were sampled following the fire in order to inventory the number of trees left following the regeneration cuts and the number of trees still alive. The areas treated by the sales from the Seven Buttes EA, portions of the Davis top and Double timber sales which were within proposed Davis Fire treatment units were identified and a sample of these was taken, with similar stands being used for each unit.

Simulation of remaining trees and fuels treatments used the "salvage" keyword in FVS. This does not allow for the retention of trees per acre, but a percentage of the trees. Following identification of the number of snags to be retained for each Management Strategy Area (MSA), numerous runs were made to estimate the percentage which came close to the desired leave tree quantity. For most plant associations and MSAs, this was found to be achieved by salvaging 90% of the trees 12"–20" in skyline and ground based logging systems and 90% of the trees 14"-20" in helicopter units; 80% of the trees 20"-36"dbh were also removed in all units. This level of salvage modeling produced average numbers of tree which were desired for snag retention (Davis Fire Wildlife Report, Kittrell). This does not include the 15% of units which would receive no treatment. Volume estimates were made using FVS estimates that following the leave tree selection 15% of the volume cut would be lost to breakage (Lowell & others 1992). Volumes used were in cubic feet and identified by species. Cull estimates to be left in the woods is imprecise since volume lost to fire is unknown and the trees valued as wildlife legacy trees are those with defect and rot. It is expected that the majority of trees with major cull in the large diameter sizes would be preferred leave trees. The volume of timber in the 12-14" diameter group was separated out and was not used for the calculation of revenues. This is because this material is marginal as a viable commercial product through time. This size group deteriorates rapidly and will lose value if delays in removal are experienced. It is, however, preferred if this material is removed in the timber sale otherwise it may incur additional costs for removal in order to achieve the desired fuel profile. Helicopter logging is a relatively expensive endeavor and the removal of 12-14" diameter trees are considered uneconomical.

The following Table 3.147 compares volumes by alternative. Volumes of trees 12" to 14" dbh are separate and not included in the analysis of costs and revenues. This separate data is provided to give an idea of volume which, while technically available for harvest, would lose economic viability over time.

Table 3.131 Comparison of Volumes by Alternatives in Hundreds of Cubic Feet (CCF)

Davis Volume Estimates (CCF[8]) by Alternative Logging System			
Sum of Volume 14"–36"		Sum of 12-14" volume	
Logging System, Alt B		Logging System, Alt B	
Ground-based	91,890	Ground-based	8,277
Helicopter	39,965	Skyline	2,600
Skyline	19,195	**Total**	**10,877**
Total	**151,050**		
Logging System, Alt C		Logging System, Alt C	
Ground-based	78,272	Ground-based	7,210
Helicopter	67,490	Skyline	696
Skyline	5,288	**Total**	**7,906**
Total	**151,050**		
Logging System, Alt D		Logging System, Alt D	
Ground-based	18,799	Ground-based	1,571

[8] Multiply by .0005 for a rough conversion to Million Board Feet

Davis Volume Estimates (CCF[8]) by Alternative Logging System				
Skyline	3,728		Skyline	494
Total	**22,526**		**Total**	**2,064**
Logging System, Alt E				
Helicopter	78,739			
Total	**78,739**			

Table 3.132 Alternative Estimated Volumes CCF by Species

Alternative B

	Total
Ponderosa Pine	66,054
Douglas-fir	25,146
Sugar Pine	1,486
Lodgepole Pine	2,772
White Fir	50,593
Shasta Red Fir	5,000

Alternative C

	Total
Ponderosa Pine	66,054
Douglas-fir	25,146
Sugar Pine	1,486
Lodgepole Pine	2,772
White Fir	50,593
Shasta Red Fir	5,000

Alternative D

	Total
Ponderosa Pine	12,759
Douglas-fir	395
Sugar Pine	1,091
Lodgepole Pine	808
White Fir	7,474
Shasta Red Fir	

Alternative E

	Total
Ponderosa Pine	29,519
Douglas-fir	13,743
Sugar Pine	1,066
Lodgepole Pine	1,020
White Fir	29,872
Shasta Red Fir	3,519

Cost Analysis

Cost analysis considers all costs through the stage of processing at which the benefits are valued or environmental effects are achieved. Costs considered are expenditure costs. When evaluating differences in logging, transport, and other access costs of forest users, all user costs do not need to be included unless differences in costs are incorporated into output values. Only the cost differences between the proposed and base alternatives are considered. An emphasis is made on variable costs, which will differ among the alternatives being considered and thus affect the decision process. Costs are assigned to each treatment or activity. These include costs of all specific inputs, and include labor, supplies, equipment, fuel, and other expenditures. Forest service costs for overhead and administration are developed on the forest level and used in all projects.

Table 3.133 Forest Service General Costs

Activity	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Project Planning	$300,000.^{00}	1^{.97}$/ccf	1^{.97}$/ccf	13^{.32}$/ccf	3^{.81}$/ccf
Sale Preparation	$0.^{00}	19^{.00}$/ccf	19^{.00}$/ccf	19^{.00}$/ccf	19^{.00}$/ccf
Sale Administration	$0.^{00}	10^{.01}$/ccf	10^{.01}$/ccf	10^{.01}$/ccf	10^{.01}$/ccf

Logging Costs

The Davis Fire recovery salvage operation costs were developed for all alternatives. Cost to the purchaser were developed using logcost50.xls, Updated 2/04. This is a spreadsheet also developed by Steve Rheinberger, a logging systems specialist with the USDA Forest Service (available at http://www.fs.fed.us/r6/nr/fp/FPWebPage/ForestProducts/ForestProducts.htm). It is a stump-to-truck costing program ($/CCF, MBF, Tons). This program includes costing routines for skyline, tractor, mechanized, loader (shovel), and helicopter yarding systems. The spreadsheet is capable of calculating costs for individual harvest units and by logging system. The information for input and selection of equipment to use and limitations of each was discussed with Forest Service employees who are acquainted with the needs of the Davis Fire area. These people include Steve Finneran, Linda Fitzer, Vicky Dunaway, Ken Kittrell, Steve Bigby, Rick Toupin, and Steve Rheinberger. The generated outputs display the costs per hundred cubic feet per unit to remove the material. The following table shows the average cost per ccf to get timber to the road by system.

Table 3.134 Logging Cost per ccf by Logging System and Alternative

Logging System	Alternative A		Alternative B		Alternative C		Alternative D		Alternative E	
	$/ccf	Volume ccf	$/ccf	Volume ccf	$/ccf	Volume ccf	$/ccf	Volume ccf	$/ccf	Volume ccf
Skyline	$0.00	0	$52.18	19,195	$ 51.33	5,288	$56.30	3,727	$0.00	0
Ground-based	$0.00	0	$40.29	91,891	$40.35	78,272	$40.36	18,800	$0.00	0
Helicopter	$0.00	0	$113.73	39,965	$114.03	67490	$0.00	0	$113.82	78,741
Average/Total	***$0.00***	***0***	***$61.23***	***151,050***	***$73.66***	***151,050***	***$42.99***	***22,527***	***$113.82***	***78,741***

The logging costs by unit were added to costs of activities, including mitigation measures, to meet the resource objectives of the Davis Fire Recovery Project. These include:

- Cleaning of equipment to reduce the potential of spreading nonnative invasive plants.
- Temporary road construction for access.
- Fuels Treatments to reduce the potential fuels loadings to levels suitable for application of prescribed fire in order to mimic historical fire processes. These include:
    - Grapple piling (on ground-based salvage units) with machinery along skid trails.
    - Felling of small diameter dead trees.
    - Utilization or burning of slash accumulated from salvage operations and small diameter fuel reduction activities.
- Decompaction or Subsoiling of landings, main skid trails, and roads, both temporary and inventoried, to reduce detrimental soil conditions and increase soil productivity.
- Planting of a diversity of conifer species important for long-term wildlife habitat objectives within the LSR.
- Protection of planted conifers from animal damage (where necessary) to ensure a successful establishment.

The following table identifies activity costs using fixed and overhead assessments:

Table 3.135 Post Harvest Treatment Costs

Activity	Cost	Unit of Measurement
Weed Treatment	$43.50	Cleaning per machine
Temp Road construction & Removal	$10,000.00	Per mile
Fuels Treatments		
Grapple Piling	$125.00	Per acre
Whip falling	$90.00	Per acre
Jackpot Burning	$60.00	Per acre
Sub soiling	$95.00	Per acre
Planting of Conifers	$350.00	Per acre
Big Game Repellant	$120.00	Per acre
Pocket Gopher Control (trapping)	$110.00	Per acre

Inclusion of Activities not connected to Salvage Activities

Reforestation planned outside the salvage units was included in the over-all costing as was decommissioning of roads. These costs were included here to evaluate the total need for the action alternatives costs with other benefits achieved. The amount of area estimated to need Big Game Repellant (BGR) for protection of seedlings from deer and elk browse damage and gopher control use costs derived from reforestation in similar plant associations. The actual need would be assessed using surveys that monitor populations and damage thresholds in order to identify actual locations and implement the proposed activities for the dictated duration of treatments. The effects associated with these activities are discussed in the appropriate sections.

Economic Efficiency

Economic or Financial Efficiency for the Davis Fire Recovery EIS was conducted with the available costs and expected timber volumes. All costs and revenues need to be made into common year dollars which following Forest Service Manual direction (FSM 1909.17) is current year dollars. There is probably not one "best " measure of economic efficiency, it being dependent on which input is most scarce or most limiting for the project. Here we will use the investment and operating funds required to put and keep lands in production of desired resources. This analysis will use Present Net Value (PNV) which is the Present Benefit Value (PVB, present revenue values) less the Present Cost Value (PVC). The Present Net Value allows comparison of alternatives as to the differences in net value of the outcomes. Positive values indicate more revenues than costs while a negative value indicates more costs than revenues. The other measure used is the Benefit / Cost Ratio (B/C). This is the present value of benefits (PVB, present revenue values) divided by the Present Value of Costs (PVC). It is a simple gauge of the relative efficiency of amounts of investment and operating funds to produce benefits. A Benefit / Cost ratio greater than one indicates more revenue than cost, and less than one indicates

more costs than revenues. The efficiency analysis does not provide the final decision itself, but rather provides an understanding of the different efficiencies of each alternative.

To assess the economic efficiency of the recovery alternatives the costs and anticipated timber volumes were entered into TEA.ECON at (http://www.fs.fed.us/r6/nr/fp/FPWebPage/ForestProducts/ForestProducts.htm). This program is an economic analysis tool developed by Steve Rheinberger, a logging systems specialist for the USDA Forest Service. It allows the user to evaluate timber sale economics at the planning or sale layout level. The timber sale economics are based on current and/or future sale data specified by the user. The spreadsheet uses price and cost data based on dollars per CCF (hundreds of cubic feet or cunits). The spreadsheet includes "cash flow" and "non-timber value" screens as well as screens which summarize net present value and benefit-cost ratios. Timber sale projects can be evaluated by individual units or by the sale-as-a-whole. The spreadsheet uses the Transaction Evidence Appraisal (TEA) system to generate basic gross timber values and estimated advertised rates. Values for timber are generated using advertised rates in the economic zones of the Forest. These rates were updated for the analysis on March 3, 2004. Timber Values were not available for Shasta red fir or sugar pine. For these white fir and ponderosa pine values were used respectively. Estimating value and volume loss of salvaged material is highly variable and dependent on species, diameter of trees, time since death site conditions severity and season of burn and the deterioration agents in the area. Value loss can be caused through product degrade, staining and checking. Volume loss is caused by checking, decay, breakage and char (Lowell & others 1992). The revenues which TEA.ECON generated for the salvaged material in each alternative were not adjusted for this value loss. This was not done since the actual value and volume loss will be similar for all alternatives and this analysis is best used as a comparative analysis of alternatives. A Society of American Foresters Conference (SAF) conference in central Oregon in 2003, estimated the loss per thousand board feet per summer month is 100 dollars per thousand board feet. At the same conference, a Pacific Northwest Research Station scientists presented information showing volume losses of up to 20% after two years in fire-killed trees, with a value loss of up to 50% from a fungi that creates a stain.

The following tables show the estimated volumes for each alternative (not including trees 12”-14” dbh) the estimated Present Net Benefits (Revenues), Present Net Costs, Present Net Value and the Benefit Cost Ratio. The first table includes costs associated with only the salvage units. This excludes road decommissioning and planting not associated with the salvage units. The second table includes the costs of road decommissioning and reforestation outside salvage units along with revenues and costs inside salvage units to show the investment needed to restore the fire area. None of the tables includes the fuels treatments outside the salvage units.

Table 3.136 Alternative Financial Efficiency Salvage Units Only

Alternative	Estimated Volume CCF	Present Net Benefits (PNB)	Present Net Costs (PNC)	Present Net Value (PNV)	Benefit / cost Ratio (B/C)
Alternative A	0	$0.00	$300,000.009	-$300,000.00	0
Alternative B	151,050	$9,857,088.00	$7,036,088.00	$2,821,008.00	1.40
Alternative C	151,050	$8,201,211.00	$7,020,875.00	$1,180,336.00	1.17
Alternative D	22,526	$1,487,006.00	$1,277,922.00	$209,084.00	1.16
Alternative E	78,739	$1,470,492.00	$3,711,551.00	-$2,241,060.00	.40

[9] Planning costs for the Davis Fire Recovery Project DEIS

Table 3.137 Alternative Financial Efficiency Including Restoration Outside Salvage Units

Alternative	Estimated Volume CCF	Present Net Benefits (PNB)	Present Net Costs (PNC)	Present Net Value (PNV)	Benefit / cost Ratio (B/C)
Alternative A	0	$0.00	$300,000.00	-$300,000.00	0
Alternative B	151,050	$9,857,088.00	$7,808,782.00	$2,048,306.00	1.26
Alternative C	151,050	$8,201,211.00	$7,793,577.00	$407,634.00	1.05
Alternative D	22,526	$1,487,006.00	$1,650,516.00	-$163,510.00	.90
Alternative E	78,739	$1,470,492.00	$3,944,023.00	-$2,473,532.00	.37

The following table is a summary of the costs which are reforestation and road decommissioning outside the salvage units (this is the difference between the previous two tables).

Table 3.138 Non-timber Related Projects

	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Non-timber Costs	$0.00	$772,702.00	$772,702.00	$372,594.00	$232,472.00

Direct and Indirect Effects

In all alternatives there is the possible future management of the stands which were in the mixed mortality fire areas. These areas will develop with understory reinitiation of trees and will be managed for the varying resource needs. In this context the level of future management is not analyzed but the opportunities will be similar in all alternatives. Future stand improvement thinning in the first three decades following stand establishment in the high mortality areas of the Davis Fire may be needed to maintain stand health and desired species composition in areas of high mortality which are adjacent to viable tree seed sources. These areas were not identified and will be similar in all alternatives.

The following table shows the costs and anticipated benefits in the future years. Actual treatments will depend upon resource objectives at that time. Project work following the salvage treatment is spread over numerous years; this is due to the logistics and limitations of doing all the work in one season. Fuels reduction treatments are specifically spread over many years and are constrained by fuels conditions, safety, and air shed limitations to burning. Outyear prescribed burning includes the fuels treatment stands outside salvage units and reforestation units not included in the salvage units. These areas will have fuels levels similar or less than in salvage units and can have prescribed fire as one of the management options available. Outyear volume estimates are made using FVS modeling of a range of stands in the fire area and simulating a thinning to 80 ft^2 of basal area per acre. Outyear timber value is based on current green ponderosa pine bid rates for green timber of smaller material. Alternative A is not included since no current or future timber would be available for harvest and no prescribed fire would be introduced unless extensive outlays for piling and treating of fuels were conducted.

Table 3.139 Long Term Management Scenario by Alternative

YEAR	ACTIVITY	QUANTITY				UNIT COST	UNIT RETURN
		Alt B	Alt C	Alt D	Alt E		
2004	Timber Sales (Salvage)	151,071 ccf @ $70.57/ccf	151,071 ccf @ $58.72/ccf	22,529 ccf @ $70.00/ccf	78,749 ccf @ $20.20/ccf		$70.57/ccf $58.72/ccf $70.00/ccf $20.20/ccf
2004-2007	Whip falling	2570 acre	3225ac.	195ac.	3290 ac.	$90.00/ acre	
2004-2007	Grapple piling	3785 acre	3130ac	850 ac.		$125.00 /acre	
2004-2007	Jackpot Burning	6355 acre	6355ac	1045 ac.	3290	$60.00/ acre	
2005	Reforestation in Key Elk Area and Riparian Area Restoration	370 acre	370 acre	370 acre	370 acre	$350.00/ acre	
2005-2008	Reforestation (outside Salvage)	1675 acre	1675acre	615 ac.	250 ac.	$350.00/ acre	
2005-2009	Reforestation (Within Salvage units	6355 acre	6355 acre	1045 ac.	3290 ac.	$350.00/ acre	
2006-2009	Fuels Treatment Outside Salvage	750 acre	750 acre	1750 ac.	750 ac.	$185.00/ acre	
2005-2010	Big Game Repellant	1712 acres	1712acre		505 ac.	$120.00/ acre	
2006-2010	Gopher Trapping	1245 acre	1245acre		1075 ac.	$110.00/ acre	
2035-2040	Prescribed Fire	9880 ac.	9880 ac.	3410 ac.		$60.00/ acre	
2055-2060	Prescribed Fire	9880 ac.	9880 ac.	3410 ac.	4990 ac.	$60.00/ acre	
2065	Planning Support	75000 ccf	75000 ccf	15,504 ccf	33,063 ccf	$19.51 /ccf	
2065	Sale Preparation & Administration	75000 ccf	75000 ccf	15,504 ccf	33,063 ccf	$29.01 /ccf	
2066	Commercial Thin Harvest (9.34 ccf per acre avg 11" dbh))	75000 ccf	75000 ccf	15,504 ccf	33,063 ccf	$	$30.00/ccf
2080-2085	Prescribed Fire	9880 ac.	9880 ac.	3410 ac.	4990 ac.	$60.00/ ac.	
2105	Planning Support	172083 ccf	172083	35,574	75,862	$19.51/ ccf	

YEAR	ACTIVITY	QUANTITY				UNIT COST	UNIT RETURN
		Alt B	Alt C	Alt D	Alt E		
			ccf	ccf	ccf		
2105	Sale Preparation & Administration	172083 ccf	172083 ccf	35,574 ccf	75,862 ccf	$29.01/ ccf	
2106	Commercial Thin Harvest (21.43 ccf per acre avg 17 " dbh)	172083 ccf	172083 ccf	35,574 ccf	75,862 ccf		$50.00/ ccf

Alternative A

Selection of this alternative would result in no active management of the resources except for future fire suppression and roadside hazard tree removal. Timely return of historical fire processes in the appropriate Plant Association Groups would not be economically feasible in the foreseeable future. Alternative A would generate no current revenues to return to the treasury of the United States of America. There is, however, a cost from the expenditure of the Davis Fire Recovery analysis regardless of the alternative selected. This expenditure allows the calculation of present Net Value of a negative $300,000, the Benefit Cost Ratio with no revenues associated calculates as zero.

In relation to employment within the county for the Davis Fire Recovery this alternative will produce the fewest jobs in the short term and the long term. Other than maintenance of roads and removal of hazard trees along roads few employment opportunities will occur in the foreseeable future with this alternative.

Future timber revenues are expected to be non existent in the high mortality areas of the Davis fire. The stocking levels will not stock the stands adequately to allow harvest in the foreseeable future unless species conversion were planned (stand replacement harvest). Alternative A is not included in the management scenario tables since no current or future timber would be available for harvest and no prescribed fire would be introduced unless extensive outlays for piling and treating of fuels were conducted.

Alternative B

This alternative is the proposed action on the Davis fire recovery. It will salvage timber, treat fuels and reforest stands within the Davis fire area.

This alternative will reduce fuels from within all salvage units and various units outside the salvage units. By the third decade following salvage this alternative would allow the reintroduction of prescribed fire to mimic natural processes. The reintroduction of fire could occur in salvage units and in fuels treatment units outside of the salvage units. In the scenario table prescribed fire is reintroduced every 20 years. I n comparison to alternative A where prescribed fire would not be a viable option this alternative allows future management of the stands to develop with fire and into large diameter size trees. This alternative, as with alternative C, will plant the most acres of all alternatives this would potentially allow the removal of some timber in commercial thinning in the sixth decade following reforestation and in the tenth decade.

The financial efficiency of this alternative is the highest with total Present Net Value of over two million dollars and a Benefit Cost Ratio of 1.26. This alternative has the best ability to produce enough revenues to pay for restoration projects associated with the salvage even with possible deterioration of value and volume. When the salvage related unit revenues and costs alone are analyzed the Net Present Value is calculated at $2,821,008.00 and the Benefit Cost Ratio is 1.40

This alternative and Alternative C produce the most employment opportunity for the area. Timber sale activities, fuels treatments, reforestation, prescribed fire and future timber harvest are at a maximum of all alternatives. These activities will generate the maximum number of jobs of the alternatives. Expenses for management are also the second highest of alternatives though the efficiency is the highest since the return for the current salvage is the highest, the introduction of prescribed fire covers the same acreage as alternative C.

The following table shows the costs and possible benefits in the future years. Actual treatments will depend upon resource objectives at that time. Project work following the salvage treatment is spread over numerous years this is due to the logistics and limitations of doing all the work in one season. Fuels reduction treatments are specifically spread over many years and are constrained by fuels conditions, safety, and air shed limitations to burning. Outyear volume estimates are made using FVS modeling of the stands and thinning to 80 ft^2 of basal area per acre. Outyear timber value is based on current green ponderosa pine bid rates for green timber of smaller material.

Alternative C

This alternative is similar to the proposed action alternative B on the Davis fire recovery it will salvage timber, reduce fuels profiles on a strategic, landscape scale, and reforest areas within the Davis Fire area. It will utilize more helicopter based logging systems than in alternative B, which is the reason for the higher costs.

The financial efficiency of this alternative is the second highest with total Present Net Value of over four hundred thousand dollars and a Benefit Cost Ratio of 1.05. This alternative may have the ability to produce enough revenues to pay for restoration projects associated with the salvage even with possible deterioration of value and volume. When the salvage related unit revenues and costs alone are analyzed the Net Present Value is calculated at $1,180,336.^{00} and the Benefit Cost Ratio is 1.17.

This alternative will have less financial efficiency than alternative B but will have similar outputs of salvage, recovery and restoration. This alternative will also have less soil impact on 1,235 acres of salvage.

This alternative and Alternative B produce the most employment opportunity for the area. Timber sale activities, fuels treatments, reforestation, prescribed fire and future timber harvest are at a maximum of all alternatives. These activities will generate a similar number of jobs as Alternative B. Expenses for management are also the highest of all alternatives though the efficiency is high since the return for the current salvage is the second highest , the introduction of prescribed fire covers the same acreage as in alternative B.

The following table shows the costs and possible benefits in the future years. Actual treatments will depend upon resource objectives at that time. Project work following the salvage treatment is spread over numerous years this is due to the logistics and limitations of doing all the work in one season. Fuels reduction treatments are specifically spread over many years and are constrained by fuels conditions, safety, and air shed limitations to burning. Outyear volume estimates are made using FVS modeling of the stands and thinning to 80 ft^2 of basal area per acre. Outyear timber value is based on current green ponderosa pine bid rates for green timber of smaller material.

Alternative D

Alternative D inside the Davis LSR would have effects similar to alternative A, the no action alternative.

The financial efficiency of this alternative is low with total Present Net Value of -$163,510.^{00} and a Benefit Cost Ratio of 0.9. This alternative may have the ability to produce enough revenues to pay for restoration projects associated with the salvage. When the salvage related unit revenues and costs alone are analyzed the Net Present Value is calculated at a positive $209,084.^{00} and the Benefit Cost Ratio is 1.16

This alternative will have less financial efficiency than alternatives B and C and will have fewer outputs of salvage, recovery and restoration. Restoration would occur only outside the Davis LSR.

This alternative produces the least employment opportunity of the action alternatives. Timber sale activities, fuels treatments, reforestation, prescribed fire and future timber harvest are at a minimum of all alternatives. Expenses for management are also the lowest of all alternatives and the efficiency is the low because of costs of road decommissioning, wildlife planting, fuels treatments, planning and other fixed costs. The return for the current salvage is low but not the lowest. Future areas of prescribed fire are the least and are all outside the Davis LSR. Future opportunities for prescribed fire and timber related jobs are the least of all alternatives.

The following table shows the costs and possible benefits in the future years. Actual treatments will depend upon resource objectives at that time. Project work following the salvage treatment is spread over numerous years. This is due to the logistics and limitations of doing all the work in one season. Fuels reduction treatments are specifically spread over many years and are constrained by fuels conditions, safety, and air shed limitations to burning. Outyear volume estimates are made using FVS modeling of the stands and thinning to 80 ft^2 of basal area per acre. Outyear timber value is based on current green ponderosa pine bid rates for green timber of smaller material.

Alternative E

Alternative E will salvage and treat fuels on approximately 50% less area than in alternatives B or C and would utilize the most expensive harvest method (helicopter) exclusively.

The financial efficiency of this alternative is the lowest with total negative Present Net Value of -$2,241,060.^{00} and a Benefit Cost Ratio of 0.37. This alternative, due to the expensive logging system used, will not have the ability to produce enough revenues to pay for restoration projects associated with the salvage. When the salvage related unit revenues and costs alone are analyzed the Net Present Value is calculated at a negative 2,241,060.^{00} and the Benefit Cost Ratio is 0.40. This alternative will have the least financial efficiency of any action alternatives and will have less output of salvage, recovery and restoration than alternatives B and C. This alternative treats more acres than alternatives A and D and will have less soils impacts than any of the action alternatives since the whole project is to be logged by helicopter.

This alternative could produce half the employment opportunity for the area as alternatives B or C. Timber sale activities, fuels treatments , reforestation, prescribed fire and future timber harvest half of alternatives B and C. Expenses for management are also the high and the efficiency is the lowest since the return for the current salvage is the least. This low return is due to the increase in logging costs by helicopter logging the complete salvage. The introduction of prescribed fire covers half the acreage of alternative B.

Table 3.140 shows the costs and possible benefits in the future years. Actual treatments will depend upon resource objectives at that time. Project work following the salvage treatment is spread over numerous years this is due to the logistics and limitations of doing all the work in one season. Fuels reduction treatments are specifically spread over many years and are constrained by fuels conditions, safety, and air shed limitations to burning. Outyear volume estimates are made using FVS modeling of the stands and thinning to 80 ft^2 of basal area per acre.

Cumulative Effects

The cumulative effects of all alternatives with regard to economic efficiency in the foreseeable future are based on costs and revenues. The Cumulative effects on forest resources are discussed in other reports of the Davis Fire Recovery EIS. All Resources have a value, though many are difficult to quantify in dollar terms.

Future reintroduction of prescribed fire is expected through the next century. This will possible where reduction of fire hazard through the planning area is conducted. The value of the Action alternatives increases the area where prescribed fire can be used with costs which are reasonable to be funded. The amount of area where this is possible is variable across the alternatives as shown in the management scenario table. Alternative A, as previously described will have no viable opportunity for reintroduction of fire. Alternatives B and C will have the opportunity to reintroduce fire at a reasonable cost over 47% of the fire area. Alternative D will have the opportunity to reintroduce fire over 16% of the Davis Fire area none of which will be within the Davis LSR. Alternative E will have the opportunity to reintroduce fire reasonably over 24% of the Davis Fire area.

Within the Deschutes River Basin and in Oregon timber values have been an important part of the economy. All the action alternatives will provide some level of possible timber revenues in the future through reforesting and managing stands to meet resource objectives. In the management scenario table a very general idea of commercial thinning and selective logging was modeled based on managing the stands to be resistant to insect infestations and

fire hazard. Alternative A forgoes these possible outputs except for possible thinning and harvest in areas where high stocking occurs (adjacent to seed sources). In Alternative A any management such as thinning where regeneration becomes established will be more difficult and the investment will be difficult to protect from stand replacement fire without high investment of fuels treatments.

The future timber volumes which have the potential to occur in the reforested stands are shown in the previous scenario table and in the following summary table

Table 3.140 Long Term Volumes by Alternative

YEAR	ACTIVITY	QUANTITY				UNIT RETURN
		Alt B	Alt C	Alt D	Alt E	
2066	Commercial Thin Harvest (9.34 ccf per acre avg 11" dbh))	75,000 ccf	75,000 ccf	15,504 ccf	33,063 ccf	$30.^{00}/ccf
2106	Commercial Thin Harvest (21.43 ccf per acre avg 17 " dbh)	172,083 ccf	172,083 ccf	35,574 ccf	75,862 ccf	$50.^{00}/ ccf
Total	Total Volume first century	247,083 ccf	247,083 ccf	51,078 ccf	109,925 ccf	

These potential volumes, if harvested would provide various levels of employment through the state and region. As this shows, alternatives B and C could provide an additional quarter million ccf (est. 126 MMBF) through the next century in timber harvest. This harvest level would be in the form of thinnings to keep the stands at a healthy level. Alternative D would produce an estimated 51,078 ccf (est. 26 MMBF) and Alternative E would produce an estimated 109,925 ccf (est. 56 MMBF) of timber. These harvest levels would provide some employment in the future at multiple levels of production and support parts of the economy.

Over the last 10 years, an annual average of approximately 68.9 MMBF of timber has been sold from the Deschutes National Forest. In the near future, the amount of timber offered for sale is expected to be near the annual average for the last 5 years. The Deschutes National Forest is expected to continue offering timber for sale and is expected to continue making contributions to the local economy as a result of timber harvest activities. Alternative A would not make these contributions. Alternatives B and C would maximize these contributions with Alternatives D and E 25% and 50% of those levels respectively.

Civil Rights and Environmental Justice

Civil Rights legislation and Executive Order 12898 (Environmental Justice) direct an analysis of the proposed alternatives as they relate to specific subsets of the American population. The subsets of the general population include ethnic minorities, people with disabilities, and low-income groups.

Environmental Justice is defined as the pursuit of equal justice and protection under the law for all environmental statutes and regulations, without discrimination based on race, ethnicity, or socioeconomic status. The minority and low income populations groups living in counties surrounding the fire area work in diverse occupations. Some minorities, low income residents, and Native Americans may rely on forest products or related forest activities for their livelihood. This is especially true for those individuals that most likely reside in the rural communities adjacent to National Forest Lands, such as La Pine, Crescent, and Gilchrist, Oregon.

Direct and Indirect Effects

Alternative A – No Action

This alternative would continue the local economic situation as described under the heading "Social Impact Analysis." Opportunities for employment of minority and low income workers may arise through restoration activities, such as riparian planting and hand piling of small diameter material within the fire perimeter, but there would be no disproportional adverse effect.

Common to all Action Alternatives

Within the social context presented above, the action alternatives developed for this project have the potential to bring in workers from the outside to perform logging, reforestation, mushroom harvesting, and related activities.

While the outside workforce is more likely to be racially diverse than the local resident population, the residents have worked effectively with and supported anticipated fluctuations in the workforce expected with the implementation of an action-based alternative. The primary services needed by the workers would be food and shelter. Local businesses that can supply food (grocery stores and restaurants) and other services would capture most of the money being spent by the workers in the area. Some businesses may need to increase their employment, either by temporarily adding employees, or giving present employees more hours. This would likely result in increased local household incomes during implementation of project activities. Since these businesses have supported similar workforces in the past, capitol expansion would probably not be required.

Since reforestation activities are expected to span a period of several years and it is reasonable to expect a good proportion of the work will go to minority-based small businesses, as they have in the past. The vast majority of these businesses and their employees are based along the I-5 corridor, so again most of the disposable income from these activities would not flow into local communities.

A road closure order currently limits access for special forest products. Resources gathered for subsistence or of cultural importance, such as edible plants or animals, or materials for shelter, are not likely affected by any federal action proposed within the fire area. Future decommissioning the 4660-600 road (as recommended in the roads analysis) will eliminate the opportunity to camp along this section of Odell Creek by vehicle access. Reducing the amount of dispersed, non-fee camping available in the project area may have a larger impact on lower income families; however, there are numerous other available locations in and near the Davis Fire area for free camping.

Recent research by the Center for Watershed and Community Health outline both the direct and indirect effects of wildfire on the health and welfare of impoverished individuals, families, and communities. Beside the direct impacts of the fire on potential jobs and income, there are also negative impacts to the value of property and other assets created by the public perception of risk created by local wildfires. The long term effect of a decrease in a sustainable local timber supply for local mills combined with a short term decrease in recreational opportunities can also affect major local employers and taxpayers. This means that the tax base decreases and the costs of sustaining local services cost more. Thus poor householders in local communities are especially vulnerable to the fallout of a wildfire like this on their local economy. They have limited financial ability to cope with the disruptive effects this may have on local economic activity and dependent social services. The effects discussed in this section, are very difficult to measure, but would tend to have a disproportional impact on local low income households. In contrast, minority groups from outside the immediate area would, whether harvesting forest products or helping in reforestation and restoration efforts, probably see fewer changes in income when compared to other groups.

Air Quality

Smoke

Air quality would be affected primarily by smoke produced during prescribed fire and pile burning proposed in Alternatives B, C, D and E. Under Alternative A, no prescribed fire or pile burning is proposed though there would be smoke production with a future wildfire.

The principle impacts of burning forest residues, whether by prescribed fire or wildfire, relate to temporary visibility reductions and effects on human health. Emissions from fire (smoke) results in the release of particulates into the atmosphere, possibly affecting the health of forest workers, visitors and residents of southwestern Deschutes County, and northern Klamath County. According to the Clean Air Act of 1977 and 1990, Federal Land Managers will attempt to "protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare..."

The critical pollutants thought to affect human health include particulate matter emitted in smoke that is less than 10 microns in diameter (PM10). Particulates less than 10 microns are able to traverse the nose and mouth (known as the "extra thoracic airway") and enter the upper airways starting with the trachea. Due to their very small size and weight (the average human hair is 70 microns in diameter), PM10 can remain airborne for weeks. Over ninety percent of smoke particles are less than 10 microns. Wood smoke has been documented to be mutagenic, though no direct studies have proven it is carcinogenic to humans. Mutagenic compounds cause changes to the structure of a cell in ways that can be transmitted during cellular division. This is of primary concern because mutations can be precursors for cancer [Boutcher, 1992]. Exposure to PM10's aggravates chronic respiratory diseases such as asthma, bronchitis and emphysema.

Burning debris will release carbon dioxide and water (making up about 90% of the total mass emitted from the combustion process), criteria pollutants (those pollutants regulated by the EPA under the clean air act), including carbon monoxide and sulphur/nitrogen oxide, and hazardous air pollutants (also known as ("air toxins"). Air toxins include several hundred known substances including the class of compounds known as aldehydes (formaldehyde's, acetaldehyde and acrolin) and polynuclear aromatic hydrocarbons (PAHs), several of which are known to be carcinogenic.

Research to date has yet to determine if levels/durations of exposure to these pollutants from prescribed fire operations are significantly affecting human health. However according to sources at the EPA, particulate matter that exceeds human health standards have been measured up to three miles downwind of prescribed burns. Also, according to studies conducted by the California Department of Health Services, John Hopkins University and the National Institute for Occupational Safety and Health, small but significant changes in pulmonary function occur when wild land firefighters are tested before and after a single fire season. Wild land firefighters exposure to CO over a full shift are generally well below occupational health limits, but there were some brief (1-minute) peak exposures that exceed short- term ceiling limits (not to be exceeded for any amount of time) of 200 parts per million.

Smoke Management would be regulated by the Department of Ecology and The Oregon Department of Forestry according to the Oregon Smoke Management Plan Oregon Revised Statutes 477.013.

The policy of the plan is to improve the management of prescribed burning as a forest management and protection practice; and to minimize emissions from prescribed burning consistent with the air quality objective of the Interim Air Quality Policy on Wildland and Prescribed Fires, Federal Clean Air Act, and the State of Oregon Clean Air Act Implementation Plan developed by the Department of Environmental Quality under ORS 468A.035 [1989 c.920 s.2].

The State Forester will:

1. Coordinate the administration and operation of the plan
2. Issue additional restrictions on prescribed burning in situations where the air quality of the entire state or any part thereof is, or would likely become, adversely affected by smoke.
3. Issues daily burning instructions when needed.

4. Annually evaluates state-wide burning operations under the plan and provides copies of the summary to interested parties.

The Department of Environmental Quality will:

1. Maintain real time air quality monitoring network that is used by ODF;
2. Provide information on field burning activities;
3. Establishes criteria for air pollution emergencies and notifies ODF of episode stages such as alerts, warnings, and emergencies;
4. Regulates the emissions of air pollutants to ensure compliance with adopted standards, limits, and control strategy plans. The ODF smoke Management Plan is jointly developed plan that governs prescribed burning;
5. Notifies the Department of Forestry when the air in the entire State or portions thereof is or would likely become adversely affected by smoke.

Federal Land Management agencies (U.S.D.A., Forest Service (USFS)) are required by law to follow the directions of the Forester for the protection of air quality in conducting prescribed burning operations. They will follow the smoke management weather forecasts and smoke management instructions, as provided by the Oregon Smoke Management Plan and the Operational Guidance for the Oregon Smoke Management Program, (Directive 1-4-1-601). Agency officers in restricted area will make daily reports relating to burning operations.

Location of proposed prescribed fire and pile burning activity is shown on the alternative maps. The table below displays the type of burning proposed and an estimate of smoke emissions using an estimate of tons per acre of fuel consumed during the burning operations. Pile and burn is the fuel treatment proposed for ground-based salvage units, and jackpot/underburning is proposed for skyline and helicopter units. Fuel treatment-only units are shown as pile and burn with lower average fuel consumption. Burning of landing piles for all units is included in the estimates for consumption.

Table 3.141 Estimated Smoke Emissions for Fuel Treatments

Fuels Treatment	PM <10 – lbs/Acre	PM<2.5 – lbs/Acre	Ave. Consumption Tons/Acre
Pile and Burn	380	320	19
Pile and Burn in Fuel Treatment Units	289	240	11
Prescribed Fire – Jackpot/Underburn	190	145	5
For comparison a WILDFIRE burning under severe conditions	720	600	30

The effects of the alternatives on smoke emissions are primarily related to the amount and type of fuels treatment proposed. The table below displays the estimated smoke emissions for the alternatives.

Table 3.142 Smoke Emissions by Alternative

Alternative	Acres Treated	Total Tons PM<10	Total Tons PM<2.5
Alternative A – No Action	0	0	0
Alternative B – Proposed Action Pile and Burn	3178	604	508

Jackpot/Underburn	2570	244	186
Pile and Burn in Fuel Treatment Units	1450	210	105
Total	**7198**	**1058**	**799**
Alternative C –			
Pile and Burn	2523	479	404
Jackpot/Underburn	3225	306	234
Pile and Burn in Fuel Treatment Units	1450	210	174
Total	**7198**	**995**	**812**
Alternative D –			
Pile and Burn	850	162	136
Jackpot/Underburn	195	19	14
Pile and Burn in Fuel Treatment Units	1750	253	210
Total	**2795**	**434**	**360**
Alternative E –			
Pile and Burn	0	0	0
Jackpot/Underburn	3290	313	239
Pile and Burn in Fuel Treatment Units	1450	210	174
Total	**4740**	**523**	**413**

All prescribed fire and pile burning would be conducted under the State of Oregon Smoke Management System to track smoke produced and would be coordinated through Oregon Department of Forestry.

Prescribed fire and pile burning would be conducted under favorable smoke dispersal conditions, avoiding impacts to Class I airsheds and urban areas. Inversion conditions, which would increase the potential for smoke pooling in valleys and drainages, would be avoided during burning operations.

The City of Bend is an area where air quality is of interest and it is closely monitored for smoke intrusion and effects from prescribed fire. Bend is located approximately 30 air miles from the Davis area. Burning done under favorable smoke dispersion conditions would not affect air quality in Bend.

Visual Effects

Visual effects to Class I airsheds would be minimal since these airsheds are higher in elevation than the majority of the project area. The nearest Class I airshed is Diamond Peak Wilderness located approximately 10 miles west of the Davis project area. The prevailing wind patterns reflecting a westerly or southwesterly flow would result in minimal potential for impacts.

Dust

Dust would be created from proposed operations in Alternatives 2 and 3, such as log haul on roads and operation of machinery within treatment units. Dust abatement and signing would be conducted on haul routes to minimize effects to public safety. Dust created during operations would be short term.

The Clean Air Act

The closest Class 1 airshed is the Diamond Peak Wilderness, immediately adjacent to the planning area. Class 1 designation does not allow human-caused activities outside the wilderness to adversely affect air quality within the wilderness.

Custodial activities such as wildfire suppression occur regardless of which alternative is selected. Although human-caused impacts are of consequence to the wilderness values (Forest Plan, Appendix 4-19), implementation of Alternative 1 (No Action) has the greatest likelihood for impacting the adjacent wilderness airshed because of the overall risk of an uncontrolled release of particulate matter resulting from wildfire.

Planned prescribed burning implemented under the action alternatives is limited to possible disposal of handpiles and jackpot burning within skyline corridors . Because of measures designed to disperse smoke during favorable conditions, implementation of action alternatives are expected to protect air quality related values and have no visible impact to the adjacent Diamond Peak wilderness area.

Other Disclosures

Forest Plan Amendment

The proposed revised Visual Quality standards and guidelines would not significantly change the forest-wide impacts disclosed in the Deschutes National Forest Land and Resource Management Plan Environmental Impact Statement, based on the following factors:

Timing: The Forest Service Planning Handbook (1909.12, 5.32) indicates that a change is less likely to result in a significant plan amendment if the change is likely to take place after the plan period (the first decade). This plan amendment would take place on the 14th year of the Forest Plan, would take place immediately, and is specific to this project.

Location and Size: The proposed revised Visual Quality standards and guidelines are site specific and would only affect the area within the Davis Fire Recovery Project area boundary for approximately 100 acres.

Goals, Objectives and Outputs: The proposed revised Visual Quality standards and guidelines would not alter the long-term relationship between levels of goods and services projected by the Land and Resource Management Plan. This amendment would not change management allocations where programmable timber harvest could occur. There would not be any significant change in timber outputs over what might be available if the project was designed without the proposed amendment.

Management Prescriptions: The proposed revised Visual Quality standards and guidelines would not change the desired future condition for land and resources from that contemplated by the existing management direction in the Land and Resource Management Plan in the short-term. It would not affect the whole Land and Resource Management Plan planning area, but only approximately 100 acres of National Forest System lands within the Davis Fire Recovery Project area. The proposed amendments would not change the Land and Resource Management Plan allocations or management areas.

Short-term Uses and Long-term Productivity

NEPA requires consideration of the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity (40 CFR 1502.16). As declared by Congress, this includes using all practicable means and measures to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

The Multiple Use – Sustained Yield Act of 1960 requires the Forest Service to manage National Forest System lands for multiple uses (including timber, recreation, fish and wildlife, range, and watershed). All renewable resources are to be managed in such a way that they are available for future generations. The salvage and use of standing timber can be considered a short term use of a renewable resource. As a renewable resource, trees can be re-established and grown in again if the productivity of the land is not impaired.

Maintaining the productivity of the land is a complex, long-term objective. All alternatives protect the long-term objective of the project area through the use of specific Forest plan Standards and Guidelines, mitigation measures, and BMPs. Long-term productivity could change as a result of the various management activities proposed in the alternatives. Timber management activities would have a direct, indirect, and cumulative effect on the economic, social, and biological environment. Those effects are disclosed in Chapter 3 of this analysis.

Soil and water are two key factors in ecosystem productivity, and these resources would be protected in all alternatives to avoid damage that could take many decades to rectify. Sustained yield of timber, wildlife habitat, and other renewable resources all rely on maintaining long-term soil productivity. Quality and quantity of water from the analysis area may fluctuate as a result of short-term uses, but no long-term effects to water resources are expected to occur as a result of timber management activities.

All alternatives would provide the fish and wildlife habitat necessary to contribute to the maintenance of viable, well distributed populations of existing native and non-native vertebrate species. The abundance and diversity of wildlife species depends on the quality, quantity, and distribution of habitat, whether for breeding, feeding, or resting. Management Indicator Species are used to represent the habitat requirements of all fish and wildlife species found within the project area. By managing habitat of indicator species, the other species associated with the same habitat would also benefit. The alternatives vary in risk presented in both fish and wildlife habitat capability.

None of the alternatives would have an effect on the long-term productivity of timber resources. Although the length of time and success rates vary among various regeneration scenarios, trees would be regenerated to provide post-fire productivity.

Unavoidable Adverse Effects

Several expected adverse effects, including some that are minimal and/or short term, were identified during the analysis. Resource protection measures or mitigations were identified and considered for each of these as a means to lessen or eliminate such effects on specific resources. See mitigation measures starting on page 2-32. Resource areas determined to have potential adverse effects (resulting from any of the alternatives – including No Action and the Action Alternatives) are documented within the appropriate Environmental Consequences sections of each resource in Chapter 3. See the following sections:

- Forest Vegetation and Timber Management
- Wildlife Habitat: Northern Bald Eagle, Northern Spotted Owl
- Fish Habitat: Bull Trout, Interior Redband Trout
- Scenic Resources
- Cultural Resources
- Soil

Irreversible and Irretrievable Commitment of Resources

NEPA requires that environmental analysis include identification of ". . . any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented." Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the use of these resources have on future generations.

Irreversible effects primarily result from use or destruction of a specific resource (e.g., minerals) that cannot be replaced within a reasonable time frame.

Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (e.g., disturbance of wildlife habitat); or is lost as a result of inaction (e.g., failure to monitor and treat forest vegetation to prevent infestation of insects).

The proposed fire salvage project would result in few direct and indirect commitments of resources; these would be related mainly to timber harvest operations.

For the proposed alternatives, most resource commitments are neither irreversible nor irretrievable. Most impacts are short term, temporary, and are being mitigated as outlined in project design criteria and best management practices. Others that may have a longer effect can be reduced through appropriate measures. Those resources that may have a possible irreversible or irretrievable commitment are discussed below.

With the implementation of any of the alternatives (including No Action), a variable portion of one primary resource (standing dead trees) would be irretrievably lost to use either as a natural resource for the harvest of commercial forest products or as a component of wildlife habitat, particularly cavity dependent species. These tradeoffs, as they relate to each of the alternatives, are explored in discussions of two topics in Chapter 3:

• Economic and Social Analysis
• Wildlife Habitat

The analysis revealed no significant irreversible or irretrievable commitment of resources associated with implementing the alternatives that are not already identified in the Deschutes National Forest Plan FEIS.

Incomplete and Unavailable Information

Predictions of effects were made with the most current information available. The following information is either unavailable or incomplete.

Fish Habitat

Information is unavailable in regards to the rearing area substrate embeddedness of Odell Creek. Qualitative observations of embeddedness by the fisheries biologist rated reach 1 (the reach within the fire perimeter) as functioning properly. However, reaches 2 and 3 appear to be functioning at risk. The higher gradient stream channel in the upper reaches coupled with few large wood jams, has led to a series of very long riffles with relatively large substrate size. This scenario typically results in smaller substrate material being flushed out during peak events, leaving only the larger, bed-armoring substrate behind.

Information regarding reaches 2 and 3 is considered inconsequential in the context of this analysis because the reach within the fire perimeter (reach 1) is the most important for determining effects of direct and indirect actions. It was determined that the implementation of the action alternatives would have a low potential for sedimentation. From a cumulative perspective, there would be a short term condition because a minor amount of silt would be flushed out with the next water event. Also, activities would occur during the ODFW in-stream work period when bull trout are absent. The long-term effect of these projects would be beneficial to stream quality as sediment mobilization and transport would be reduced.

Also, limited information is available for Moore and Ranger Creeks as it relates to bank stability. However, a site visit determined the areas of instability were small and often associated with the loss of vegetation resulting from fire. Streambanks would not be negatively affected through implementation of any of the five alternatives.

Consistency with the Clean Water Act and 303(d) Listed streams

All alternatives are consistent with the Clean water Act.

The conditions that reduce the likelihood that proposed activities are capable of exacerbating watershed conditions and affecting water quality include:

The Davis Fire occurred in the “bottom” of the subwatersheds which is considered as a relatively closed system at Davis Lake (figure 1).

Proposed activities are in soils that are well-drained (i.e. pumiceous).

Best Management Practices will be employed (see mitigations section).

There are no proposed salvage harvest activities within Riparian Reserves or Riparian Habitat Conservation Areas.

All planned activities have been determined to meet Aquatic Conservation Strategy and Riparian Management Objectives.

Effect on 303(d) Parameters

Implementation of the action alternatives would include no salvage treatments within RHCA/RR buffers in order to reduce disturbance within sediment delivery zones identified during the analysis. Oregon administration rules states, “No more than 10 percent cumulative increases in natural streams turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity” (OAR Chapter 340, Division 41-DEQ). The action alternatives also propose to close road 4660/600 and associated dispersed

camping spurs along Odell Creek which would reduce vehicular disturbance within the buffers and reduce hydrologic connectivity of the road system with Odell Creek

Odell Creek is listed on the ODEQ 2002 303(d) list as "Water Quality Limited" (ODEQ 2002). The entire length of Odell Creek is listed for temperature that exceeds the standard for salmonid rearing (64 ^{0}F) and spawning (55 ^{0} F).

Post-fire cover conditions as a result of the Davis Fire would continue to have the greatest affect on water quality. Although the primary factor influencing elevated stream temperatures is the outflow of warm water from Odell Lake during the summer months, temperatures in the lower reach of Odell Creek are susceptible to increases over the next few years as a result of the loss of shade provided by conifers within the riparian buffer.

Water temperatures of Odell Creek and Davis Lake would only slightly be impacted by the action alternatives in the next few years. Small diameter non-commercial fuels treatments surrounding developed sites at Davis Lake are would not have a measurable effect on stream temperature. Portions of two fuels treatment units are within the riparian buffer in which a few standing snags that currently provide some solar deflection would be removed. Approximately 1.5 miles of Odell Creek would be replanted with lodgepole seedlings to provide an immediate return of conifers capable of providing shade to the stream possibly sooner than under the no action alternative. These seedlings would not be expected to provide significant amounts of shade capable of minimizing temperature increases in the lower reaches of Odell Creek for a number of years. The addition of planted conifer seedlings may also allow for an increased accumulation of snow in these areas as well as a delay in snowmelt that could help minimize water temperature increases sooner when compared to the no action alternative.

Crescent Creek is within the same watershed as the Davis Fire and is also 303(d) listed for exceeding the standard for temperature. There is no drainage connecting Crescent Creek or its tributaries from the fire area. There will be no effects from the fire on Crescent Creek's temperature.

Sedimentation

Due to the depth of the high porosity pumice soils and glacial outwash, stream density is very low in the analysis area. Predicted increases in sediment delivery to streams as a result of active management alternatives would be negligible when compared to those resulting from the fire. This is due to the coarseness of the pumiceous sandy loam material, as well as the lack of significant slopes present in this project area combined with transport distances.

Forest-wide Biological Assessment and Project Design Criteria

A Biological Assessment lists the Project Design Criteria. All action alternatives comply with the applicable PDCs.

Water Quality and Human Health

There was a possibility that fire retardant may have entered Odell Creek during the wildfire suppression activities. Although no Sulfates and nitrates that could reach surface flows of Odell Creek or Davis Lake via tributary groundwater sources after leaching through the soil profile should be in limited concentrations due to dilution factors provided by the volumes in each waterbody. Neither surface waterbody is a direct drinking water source and there are no water quality standards for nitrate in wild land surface waterbodies. There are two wells that provide drinking water at East and West Davis campgrounds located within a mile of three retardant drop points. These wells are drilled at a depth of 65 and 80 ft, respectively. National drinking water standards for nitrates in public drinking water supplies are 45 mg/l nitrate or 10 mg/l nitrate nitrogen (Stednick 1991). Pre-fire monitoring data of these supplies shows nitrate levels of <0.1 mg/l nitrate (North Creek Analytical 2003). The water sources have been shut off since the fire event and have not been measured for water quality. Regular protocol for these sources has been annual tests for nitrate and coliform levels.

Treatment of noxious weeds with the herbicide Dicamba will continue along Highway 46. It is not expected to reach any water bodies as the herbicide is applied for spot treatments, and is sufficiently far enough away from any water body. There are no stream crossings along the FS 46 and therefore no delivery mechanisms to carry the herbicide directly to Odell Creek or Davis Lake. The herbicide could leach down through the soil and enter the ground water table and then be transported to the stream or lake, however by that time concentrations would not likely be great enough to pose a risk to aquatic organisms. The 1998 Deschutes National Forest Noxious Weed EA

and Decision Notice found that there are no adverse impacts as a result of treatments to public health and safety and that it was unlikely there would be impacts to public wells. There are no lands nearby. The 1998 analysis was in context to a forest wide analysis and its effects analysis as it relates to human health and protection of 303(d) water quality parameters hereby incorporated into this analysis.

Northwest Forest Plan LSR Standards and Guidelines

Salvage

The scale of salvage and other treatments should not generally result in degeneration of currently suitable NSO habitat or other late successional condition (C-13).

All salvage is proposed in stands where there is 100% mortality. The only treatments proposed in suitable NSO habitat or LS conditions are strategic small diameter, non-commercial thinning to provide fuel breaks. These units would be limited to trees at or below 12" dbh (6" dbh in NRF), on 13-15 foot spacing depending on density of trees larger than 8". Since no overstory removal would occur, NRF habitat would not be compromised and suitable characteristics would remain.

In all cases, planning for salvage should focus on long-range objectives, which are based on desired future condition of the forest (C-14).

The Davis Fire Recovery Project Proposed Action has focused on accelerating the achievement of long-range objectives which are based upon desired future condition of the Management Strategy Areas specified in the Davis LSRA. Regardless of whether the management is for northern bald eagle or northern spotted owl, which can have opposing habitat requirements, the Davis LSRA specifies fuel levels that are suitable for those species and sustainable for fire-adapted ecosystems. The proposal is to provide rapid establishment of tree species and sizes important for the management of these species first, and then attainment of the other attributes such as multiple canopy structure for NRF.

Salvage guidelines are intended to prevent negative effects, while permitting some commercial wood volume removal. Management following a stand-replacing event should be designed to accelerate or not impede the development of those conditions (C13, 14).

Proposed activities are designed to accelerate development by reducing levels of fuels to suitable and sustainable levels specified in the Davis LSRA. If no action were taken, FVS models indicate achievement of desired sizes and species of trees for LOS habitat would be delayed by at least 100 years.

Remove conservative quantities of salvage and retain management opportunities (C-14).

Salvage is proposed on roughly 5,087 acres within the Davis LSR. Only dead trees are proposed for salvage, and a conservative definition of dead is used for this project: dead = no visible live needles. The pattern of the burn resulted in areas that are clearly live or dead.

Trees that survived the last stand replacement event are generally 36" dbh or larger. These trees that are dead would not be proposed for salvage. For the remaining snags, in order to meet desired levels, retention would range from 12-35 inches dbh, prioritizing the largest in that category for retention (table 3.40). In addition to these levels referenced in table 3.40 and unsalvaged areas, an additional 15% of each unit would be designated for retention in an unsalvaged condition. These levels specified in the proposed action meet or exceed those levels recommended in the LSRA.

No salvage if opening is less 10 acres or canopy closure greater than 40% (S&G #1of C-14).

Salvage in LSRs is only proposed in openings > 10 acres. Stands have experienced total mortality, therefore no canopy exists.

Retain standing live trees (S&G #2 for C-14).

There is no cutting of live trees proposed.

Retain snags likely to persist until late successional conditions have developed (approximately 80 years) (S&G #3 for C-14).

Retain largest hard-snags, as they are more persistent, and emphasize retention of pine and Douglas-fir, as they are persistent and have greater value for wildlife than other species. Douglas fir and ponderosa pine are the most common species of large snag in the recovery area. See snag retention report for retention levels for varying site conditions. Average snags retained per acre would be the largest and exceed LSRA guidelines. Snags 36" and greater, the ones most likely to persist, would be retained. These larger sizes range from 1-8 per acre.

Retain "typical" amounts of CWD found in naturally regenerated stands; province level specifications, as for snags, must be provided, including decay rates (S&G #4 for C-14).

Down wood levels within treatment units post harvest would follow levels specified in the Davis LSRA: 5-15 tons per acre in ponderosa pine PAGs (0.94-2.82% down wood cover) and 15-25 tons per acre in mixed conifer dry PAGs (2.47-4.12% down wood cover). Down wood levels would increase as snags fall.

FVS-FEE models snag fall down rates by species and dbh. The overall average is approximately 50% of the standing snags fall every decade adding to levels of coarse woody material.

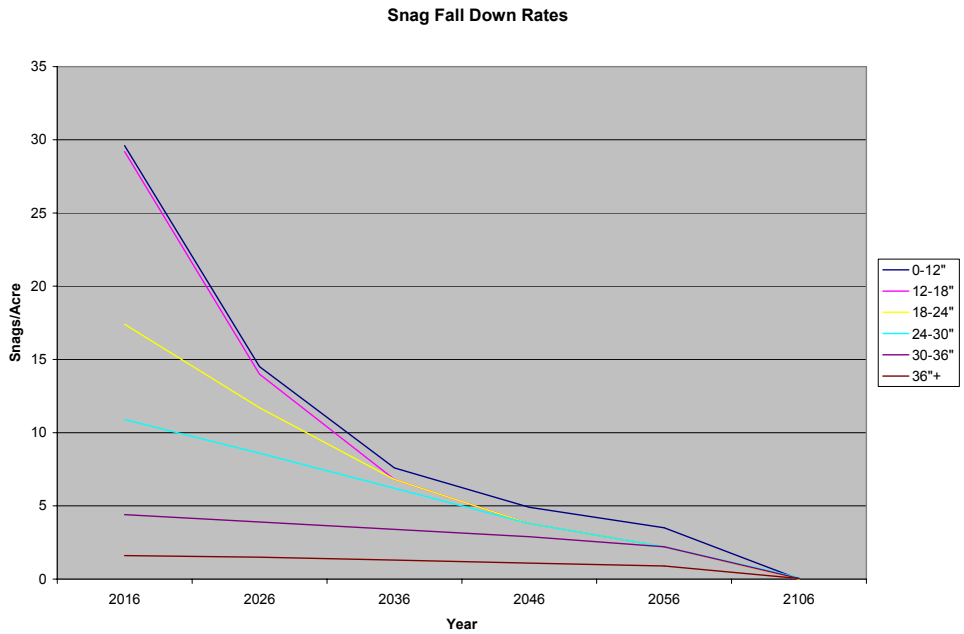


Figure 3.30 Snag Fall Down Rates

Fire, insects, pathogens, and weather are responsible for the decomposition of dead organic matter. In cold or dry environments, biological decay is limited. Fire plays a major role in recycling matter (Brown, et al, RMRS-GTR105, 2003) In other words, whatever levels of down logs retained post fire salvage, are largely affected by

the fire regime present. The Davis LSR is located on the eastside of the Cascade Mountain range, and regenerating stands generally developed under a frequent low-intensity fire regime (Davis LSRA, page 2-23).

Amounts of down woody present in developing stands has been estimated using science developed by James K Agee (PSW-GTR-181, 2002), Brown et al, and the Davis LSRA, Tables I and II, Suitable and Sustainable Desired LSR Conditions. Optimum coarse woody debris that provides desirable biological benefits in similar climate and fire regimes ranges from 5-24 tons per acre. These quantities coincide with the average amounts of large woody debris inventoried by fuels surveys and stand exams that may represent the high end of pre-settlement conditions occurrence compared to historical fire regimes. The Davis LSRA quantifies suitable and sustainable down logs at levels 12-24 tons per acre in most Plant Association Groups.

The Proposed Action would retain standing dead trees that eventually will contribute to the Coarse Woody Debris levels that exceed on 5,310 treated acres what Agee, Brown, and the Davis LSRA specify as likely existing during a normal historical fire regime (DEIS, Table 3-79, page 3-177). Proposed application of prescribed fire would reduce these levels to those more typical of an eastside system. Once fire begins to mimic a historical role and stand development of over 8,000 acres of planted fire tolerant conifers proceeds, it is estimated the contribution of coarse woody debris can begin at year 80-100 (DEIS, page 3-149).

All coarse woody debris existing pre-fire and not consumed would remain.

Salvage that does not meet S&Gs 1-4 will be allowed if it is essential to reduce future risk of fire or insect damage; most likely in eastern Cascades or in Klamath Province (S&G #5 for C-15)

Risk reduction treatments will clearly result in greater assurance of long-term maintenance of late successional forest habitat and they will not prevent the LSRs from playing an effective role in the objective for which they were established, because there clearly is a fire risk, fuel breaks and prescribed fire are proven techniques for controlling fires, and these treatments will not only "not prevent," but they are needed to assure "Late-Successional Reserves will play the effective role in the objectives for which they were established."

The Davis Fire Recovery area is dominated by conditions that are conducive to wildland fires, which is wet winters that grow fuel and long dry summers with frequent lightning storms. Historically, late successional forests in this area developed with frequent low intensity fires. Suppression of these low intensity fires over the past century increased the potential for a major stand replacing event, which happened in 2003. Continued suppression of low intensity fires would have the same results, because fire hazard will increase with time. Large fires like Davis Fire make it clear that past practices are failing to protect late successional forests and communities, and strategies that incorporate low intensity fires into land management practices are needed in fire-adapted plant communities.

Fuel breaks supported by prescribed fires are a strategy that incorporates low intensity fires into land management practices. These treatments are commonly used to effectively control wildland fires, and they were the treatments that enabled line placement on portions of line that eventually controlled the Davis Fire. These treatments would reduce fire hazard at strategic locations and increase the potential for restoring historic low intensity fire regimes at larger landscape scales by providing defensible locations where wildland fires could be controlled and prescribed fires initiated.

Proposed risk reduction treatments are designed to provide effective fuel breaks wherever possible and activities in older stands are appropriate, because (1) the proposed management activities will clearly result in greater assurance of long-term maintenance of habitat, (2) the activities are clearly needed to reduce risks, and (3) the activities will not prevent the Late-Successional Reserves from playing an effective role in the objectives for which they were established.

Removal of Hazard Trees may be necessary along roads and trails or campgrounds. Meet CWD guidelines (S&G #6 for C-15).

The Proposed Action does not include hazard tree removal. This was accomplished along 12 miles of well traveled road and in two developed campgrounds under an earlier decision.

Green-tree and snag guidelines will be applied first and completely satisfied where possible. Snags can be credited toward CWD S&G #7 (C-15)

Where live trees exist within salvage units, they will not be removed. Snag and CWD amounts will be met on 5 acre (average) areas or salvage will not occur in areas with limited amounts of snags and CWD. Additional hard snags will be retained where needed to meet CWD amounts.

These guidelines may not be applicable in younger stands because CWD may be too small. Retention should be consistent with achieving lat-successional condition (S&G #8 for C-15).

All proposed commercial units have large dead wood and would not have a problem meeting CWD requirements.

Retain soft CWD but do not credit these toward CWD requirements S&G #9 (C-15).

All existing down wood prefire would be retained.

CWD retained should approximate species composition of original stand (S&G #10 for C-15).

To meet "persistence" needs species composition will approximate "historic" composition (such as pine and Douglas-fir) of large trees.

Provide reasonable access to salvage sites and feasible logging operations on as small a portion of the area as possible and should not violate intent to "not impair" existing late-successional forest habitat or its future development (S&G #11 for C-15).

No cutting of live trees would be required to "provide reasonable access". The project's purpose and need is to facilitate development of LOS and protect the regenerating forests. Where access is limited, advanced systems were incorporated to minimize construction of temporary roads. Current access is well provided and an estimated 11 miles of temporary roads would be needed. It is likely this estimate is on the high end. Temporary roads are only used to facilitate forest management and would be closed immediately following their intended use.

Risk Reduction

Beneficial to development of late successional conditions (C-12).

The objective is to accelerate development of late successional conditions while making conifers in the future stand less susceptible to natural disturbances (C-12). Desired Future Condition for Davis fire area is habitat conditions that are ecologically adapted to the site and historic fire regimes. The desired future condition is two fold with both conditions requiring large trees. For suitable conditions, about 345 trees per acre with 10 of them over 25"dbh over 40 percent of the LSR; for sustainable conditions, widely spaced trees 8-273 per acre with 18 of them over 25" dbh over 10 percent of the LSR. Planted species would be adapted to these fire regimes and other site conditions as described by mostly dry Plant Association Groups (PAGs). Emphasize planting in areas with no natural seed sources. Selected planted species are resistant to low intensity burning at a young age.

The DEIS has projected biomass levels for untreated stands. This level has been identified as 60-90 tons per acre at year 2045 (DEIS, page 3-181). Due to the lack of seed source, the majority of natural regeneration of conifers is likely to be lodgepole pine, a fire intolerant species. The majority of the Davis Fire occurred in the mixed conifer dry Plant Association Group (PAG) and lodgepole pine is not a primary component for long term objectives.

East of the Cascade Mountain range, frequent, low intensity fire plays an important role in maintenance of long term habitat, which includes large fire tolerant trees with the limb structure suitable for nesting and roosting, and

large snags. The Proposed Action gives greater assurance that these habitat conditions would be achieved decades sooner (DEIS, page 3-188) than if no action was pursued.

Using commercial salvage, the range of biomass would be reduced by more than one-half of those levels estimated for untreated stands (DEIS, page 3-177). Also, fire tolerant conifers such as Douglas-fir and ponderosa pine would be planted and are important for long term habitat objectives.

Long term maintenance of habitat is largely connected to the historical fire regime of frequent, low intensity fires. Implementation of the Proposed Action would facilitate careful introduction of prescribed fire after 30 years; a point in time when planted trees are of suitable size and species to survive and begin to develop. Also, the fuel loadings would be reduced to levels that approximate conditions where fire intensities and flame lengths are non-lethal.

Treatments should be designed to provide effective fuel breaks wherever possible (C-13).

The Proposed Action would entail small diameter non-commercial fuels treatments (1,450 acres) in addition to commercial salvage on 5,310 acres within the LSR. Commercial salvage would only occur in stands that have no canopy closure and are 100% dead. Fuel breaks are strategically located to protect remaining live LSR, a scenic byway, and key recreation areas adjacent to Davis Lake (DEIS, page 3-178). In the central Oregon area, fuel breaks are not 100% effective due to spotting potential. Some recent fires have observed spotting up to a half mile away from the flaming front. Fuel breaks maintained by landscape prescribed fire would provide defensible space at strategic locations for stopping wildland fires, which would increase the opportunities for land managers to allow low-intensity fires to re-claim their ecological role in this fire-adapted ecosystem.

While risk-reduction efforts should generally be focused on young stands, activities in older stands may be appropriate if:

(1) the proposed management activities will clearly result in greater assurance of long-term maintenance of habitat, (C12,13)

Fuel Breaks supported with Rx burning in strategic locations will reduce potential for major stand replacing events by reducing the amount of surface and ladder fuels at a large enough scale to make a difference in this area. The primary goal of these risk reduction efforts is to restore low intensity fire, which should help assure long-term maintenance of the surviving late successional forest habitat from future high intensity stand replacing fires.

(2) the activities are clearly needed to reduce risks, and (C12,13)

Frequent annual ignitions in this area with long dry summers combined with the areas ability to develop fuels contribute to a rapidly accumulating risk of wildland fire. There is clearly a need to reduce risks.

(3) the activities will not prevent the Late-Successional Reserves from playing an effective role in the objectives for which they were established. (C12,13)

The Deschutes National Forest has lost approximately 17,500 acres of NRF over the last two years to wildfire (Joint Aquatic and Terrestrial Programmatic Biological Assessment for Federal Lands Within the Deschutes Basin 2003-2006). With a total 2004 baseline of 94,000 acres, this is about a 19% loss.

Connectivity between LSRs is necessary to provide demographic viability and genetic diversity should stochastic events (e.g., fire, insect, disease, wind storms, inclement weather) significantly reduce the population in any individual LSR. The NFWP, in theory, provides for connectivity between each LSRs by utilizing Riparian Reserves, Administratively Withdrawn Areas, Wild and Scenic River corridors, 15% green tree retention areas, and 100-acre owl activity centers for those sites that are outside of the LSRs. This theory may be valid for westside conditions, but not for the dry eastside forests found on the Deschutes NF, where riparian areas are lacking or widely dispersed, and Wild and Scenic River corridors are limited. Generally, dispersal habitat across the Deschutes NF is fragmented by roads, timber harvest units, or by areas that have been burned or defoliated

by insects or disease. The Davis Fire has caused further fragmentation to the Davis Late Successional Reserve and adjacent reserves.

The Davis Late Successional Reserve Management Strategy Areas and their long-term objectives for managing habitat for late and old forest related species would not change. Taking an active management approach now would accelerate the most limiting attribute such as large trees and NRF habitat. Planned activities would not only prevent, but accelerate reserves to play a role for which they were established.

Consistency with the Regional Forester's Eastside Forest Plan Amendment #2 (Eastside Screens)

Approximately 120 acres are proposed within the boundary of the Eastside Screens for Alternatives B, C, D, and E. The majority of the project area is within the boundary of the Northwest Forest Plan.

Interim Riparian Standard

There are no timber sales proposed in the riparian areas as described in Appendix B, Page 2 of the Interim regional Direction.

Interim Ecosystem Standard

A Historical Range of Variation (HRV) analysis was completed. No live trees are proposed for harvest, therefore the HRV would not change from the current structural stage level.

Interim Wildlife Standard - ***Scenario A***

1) and 2) There would be no harvest of live trees, therefore no change to LOS conditions.

3) Sufficient connectivity is provided by the unharvested portions including stands that experienced non-lethal wildfire. Reference the wildlife section for more details.

4) No live trees would be harvested, therefore the 21 inch diameter limit does not apply. The action alternatives are designed to meet the 100 Maximum Population Potential for MR species. Action alternatives do not propose to remove down logs existing before the fire and down log recruitment is expected to exceed levels specified on page 12 (reference the wildlife and fire and fuels section). There are no known goshawk nests in the area and the habitat most likely to be used for nesting is not proposed for harvest.

Human Health and Safety

The existing level of hazard tree management consists of a conservative approach to removal of hazard trees along approximately 12 miles of road within the interior of the fire area for roads 44, 46 (Cascade Lakes Highway), 4660, 4669, 4600850, and 6224. Hazard trees were identified as those that lean toward the travelway and have the potential to fall regardless of other environmental conditions. Remaining standing dead tree that do not lean towards the roadway, particularly in areas where the fire intensity burned moderate to severe, have increasing potential to fall on the roadway compounded through time as wood deteriorates and storm events occur. Approximately 290 miles of roads are currently available for use post-fire if the closure order was lifted.

A roads analysis for the area has been completed and recommendations include a net reduction of 28 miles of access. This has been carried forward into the design of the action alternatives. A copy of this analysis can be found in the project record at the Crescent Ranger District.

Health effects are limited in scope and duration. This analysis summarizes the human health and safety effects described in other sections of the document.

Alternative A (No Action) and D

These alternatives would present greatest potential for hazards to the visiting public from falling dead trees along roads. Although hazard tree management has been accomplished along most major travelways such as Highway 46, a decline in user safety would be expected for at least the first decade while standing trees begin to fall at an accelerated rate. In order to maintain public safety, some roads would be closed to motorized travel. This condition, including potential closure of the main access to the Cascade Lakes recreation area (Highway 46) would be most likely after storm events.

Alternative D would not proactively manage standing dead trees adjacent to the roadway within the LSR boundary (approximately 60% of the fire area), including along Highway 46, although roadside hazard tree management is proposed on well-traveled roads 6230, 6240, and 6245.

In both of these alternatives, custodial activities such as removal of trees that fall on the roadway would occur. Road closures along major roads could occur for periods ranging from a day to several weeks depending upon the severity of the event. Public access along less traveled roads could be restricted for at least a decade until the potential hazard is lessened and road maintenance could accommodate motorized use.

High levels of downed material are likely to affect future wildfire suppression actions. High levels of dead and down material and resistance to suppression efforts (control) would likely result in a higher potential to become extremely hazardous for fire fighters and visitors. Some suppression strategies would be eliminated due to lack of adequate escape routes and safety zones.

Alternatives B, C, D and E

Implementation of action-oriented alternatives here would increase the potential for encounters on roadways between equipment associated with logging, other restoration activities and visitors. This elevated level of risk would be present for the short-term (approximately 5 years). In some cases, Highway 46 would be closed to motorized travel while tree felling and helicopter operations fly logs over the roadway. Informational signing, flaggers, and road maintenance activities such as brushing roads for increased visibility would be enforced in the timber sale contract to increase safety. All other proposed activities would not expose the public to an elevated risk of injury above hazards associated with routine forest practices that are regulated by the Oregon Occupational Safety and Health Division.

Overall, beyond 5 years, the level of safe public access within the fire perimeter would be proportional to the various level of tree removal proposed among alternatives along roads that remain open. Alternatives B, C, and E would have the greatest reduction in hazards associated with remaining trees along roads after salvage activities have concluded.

Worker health effects and safety from all phases of logging operations would potentially occur. The work environment would be physically demanding and hazardous. The most hazardous activities would include tree felling and helicopter operations which have the most potential for serious injury. As part of the design of the action alternatives that include helicopter logging, dead trees designated for retention would be “clumped” to lessen the risk to workers hooking cables and other manual operations.

The Clean Air Act lists 189 hazardous air pollutants to be regulated. Some components of smoke, such as polycyclic aromic hydrocarbines (PAH) are known to be carcinogenic. Probably the most carcinogenic is benzo-a-pyrene BaP. Other components, such as aldehydes, are acute irritants. Five primary air toxins are presently being assessed relative to the exposure to humans to smoke from prescribed and wildfires:

Acrolene – An aldehyde with a piercing, choking odor. Exposure severely irritates the eyes and upper respiratory tract.

Formaldehyde – Low-level exposure can cause irritation of the eyes, nose, and throat. Long-term exposure is associated with nasal and nasopharyngeal cancer.

Carbon Monoxide – CO reduces the oxygen carrying capacity of the blood, a reversible effect. Low exposures can cause loss of time, awareness, motor skills, and mental acuity. Also, exposure, can lead to heart attack, especially for persons with heart disease. High exposures can lead to death due to lack of oxygen.

Benzene – Benzene causes headache, dizziness, nausea, and breathing difficulties, as well as being a potent carcinogenic. Benzene causes anemia, liver and kidney damage, and cancer.

The closest Designated Area to the project area is the city of Bend, Oregon, with Crescent, Chemult, and La Pine nearer, although not as well populated. The greatest risk of exposure to respiratory particulates would be to firefighters and forest workers implementing prescribed burning of the handpiles. It is unlikely the general public would be exposed to levels adverse to human health during implementation of prescribed burning operations because of the distance and the prescriptions designed to lessen the release of particulate matter. Those that suffer from breathing ailments may experience some difficulty during periods of prescribed burning and atmospheric conditions that do not favor dispersion of smoke. The Forest Service voluntarily follows the guidelines assigned by Oregon Smoke Management to limit state-wide exposure on a cumulative basis, in compliance with the Clean Air Act.

Forest workers and firefighters can face unhealthy levels of smoke when patrolling or holding fire lines on the downward edge of a wildfire or prescribed fire, or while mopping intense hot spots. In most cases, measures such as education on the effects of short and long term exposure, rotation out of the smoke, and the use of respirators can reduce exposure levels.

Prime Lands

The Secretary of Agriculture issued memorandum 1827 which is intended to protect prime farm lands and rangelands. The project area does not contain any prime farmlands or rangelands. Prime forestland is not applicable to lands within the National Forest System. National Forest System lands would be managed with consideration of the impacts on adjacent private lands. Prime forestlands on adjacent private lands would benefit indirectly from a decreased risk of impacts from wildfire. There would be no direct, indirect, or cumulative adverse effects to these resources and thus are in compliance with the Farmland Protection Act and Departmental Regulation 9500-3, “Land Use Policy”.

Compatibility with State and Local Laws

Implementation of all alternatives would be consistent with State and local laws, land use, and environmental policies.

Action alternatives follow State of Oregon requirements in accordance with the Clean Water Act for protection of waters. Application of Best Management Practices (BMPs) are selected and designed on site-specific conditions for waters potentially impacted in the Davis Fire Recovery Project area. The interdisciplinary team has reviewed and incorporated applicable BMP water quality objectives in the design of alternatives and their mitigation measures. Standards and Guidelines for the Northwest Forest Plan (Aquatic Conservation Strategy) and the Inland Native Fish Strategy where developed (in part) to maintain and restore aquatic ecosystems for dependent species. These standards and guidelines afford the same or greater protection of stream courses as direction found in the 1988 USDA publication “General Water Quality – Best Management Practices”. Protection of water quality is also provided by incorporation of BMPs in timber sale contract provisions, Oregon Department of Environmental Quality oversight for water quality monitoring in the East and West Davis potable water wells in the developed sites, and direction for road maintenance and reconstruction.

Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands)

Executive Orders 11988 and 11990 direct Federal agencies to avoid, to the extent possible, both short-term and long-term adverse impacts associated with the modifications of floodplains and wetlands. All alternatives have no specific actions that adversely affect wetlands and floodplains. Proposed activities are compliant with the orders and USDA Departmental Regulation 9500-3. See discussions related to this topic in the hydrology, fishery and soils resource sections in Chapter 3 for more information.

Davis Lake Special Interest Area

The Deschutes Forest Plan designates 16,900 acres across the Forest as Special Interest Areas with the goal of preserving the providing interpretation of unique geological, biological, and cultural areas for education, scientific, and public enjoyment purposes (LRMP page 4-90). The Davis Lake Special Interest Area (SIA) is approximately 4,230 acres (1,029 acres within fire perimeter) and consists of the lake and surrounding shoreline. Five project units overlap the SIA as displayed in the following table.

Table 3.143 Treatment Acres and Within Davis Lake Special Interest Area by Alternative and Activity

Unit #	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E
15	0	1 (helicopter)	1 (helicopter)	0	1 (helicopter)
20	0	3 (helicopter)	3 (helicopter)	0	3 (helicopter)
105	0	64 (helicopter)	64 (helicopter)	0	64 (helicopter)
350	0	6 (fuels only)	6 (fuels only)	6 (fuels only)	6 (fuels only)
370	0	59 (fuels only)	59 (fuels only)	59 (fuels only)	59 (fuels only)
Total Acres*	**0**	**133**	**133**	**64**	**133**

*These figures do not include a reduction for 15% retention areas and avoidance of riparian reserves.

Alternatives A and D do not include any salvage harvest in the SIA; three units under Alternatives B, C, and E include salvage by helicopter. All action alternatives involve small-diameter fuels reduction on 64 acres. Applicable Forest Plan Standards and Guidelines include M1 that states "Timber harvesting and vegetative management will be allowed in catastrophic situations and when necessary to meet objectives of the Special Interest Management Area" (LRMP page 4-90); and M1-18 "Fuels treatment methods should emphasize maintenance of the natural characteristics of the area. Fuel loadings should be low enough to eliminate the possibility of high intensity fires while maintaining the natural characteristics of the area" (LRMP 4-91). The proposed treatments are consistent with the objectives of the Special Interest Area. Primary benefiting uses are developed and dispersed recreation which will not be adversely affected by the proposed treatments.