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Draft Environmental Impact Statement for the Four-Forest Restoration Initiative

Coconino and Kaibab National Forests, Coconino County, Arizona

Cover photo from Kaibab NF files, courtesy of David Brewer with ERI

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Four-Forest Restoration Initiative, Coconino and Kaibab National Forests

Coconino County, Arizona

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Abstract: The Coconino and Kaibab National Forests (NFs) are proposing to conduct restoration activities over a 10-year period. Four alternatives were considered in detail. **Alternative A** proposes no action. There would be no changes in current management. **Alternatives B–D** would mechanically treat up to 593,211 acres of vegetation and treat up to 587,923 acres with prescribed fire. **Alternative C** is the preferred alternative. All action alternatives include other activities that would provide access to the project or improve soil and watershed function. All action alternatives require nonsignificant forest plan amendments.

It is important that reviewers provide their comments at such times and in such a way that they are useful to the Agency's preparation of the final environmental impact statement. Therefore, comments should be provided prior to the close of the comment period and should clearly articulate the reviewer's concerns and contentions. The submission of timely and specific comments can affect a reviewer's ability to participate in subsequent administrative review or judicial review.

Comments received in response to this draft environmental impact statement (DEIS) solicitation, including names, addresses, and phone numbers of those who comment, will be part of the public record for this proposed action. Comments submitted anonymously will be accepted and considered; however, anonymous comments will not provide the respondent with standing to participate in subsequent administrative review or judicial review.

Send Comments to: **Henry Provencio, 4FRI Team Leader**
1824 S. Thompson Street
Flagstaff, AZ 869001

Date Comments Must Be Received: The 60-day public comment period begins on the day after the Environmental Protection Agency publishes a notice of availability for the draft EIS in the Federal Register. Comments MUST be received before the close of business on the last day of the comment period.

Summary

The Coconino and Kaibab National Forests (NFs) are proposing to conduct a suite of restoration activities on approximately 587,923 acres over a period of 10 years. Of this total, approximately 356,115 acres would be treated on the Flagstaff, Mogollon, and Red Rock districts of the Coconino NF and 231,809 acres would be treated on the Williams and Tusayan districts of the Kaibab NF.

The purpose of the project is to reestablish and restore forest structure and pattern, forest health, and vegetation composition and diversity. There is a need to increase forest resiliency and sustainability, protect soil productivity, and improve soil and watershed function. Resiliency increases the ability of the ponderosa pine forest to survive natural disturbances such as fire, insect and disease, and climate change (FSM 2020.5).

Over 50 percent of the ponderosa pine is even-aged and lacks age class diversity. The single-age forest structure has reduced the health of the ponderosa pine forest. Large, old ponderosa pine trees are rare across the landscape. The remaining old pines are at risk of mortality from the increased overcrowding of trees (stand density related mortality) and the potential for severe fire effects.

In contrast to having a ponderosa pine ecosystem consisting of groups of trees mixed with interspaces, approximately 74 percent of the ponderosa pine forest type within the project area is departed from desired conditions. Non-forested openings have been invaded by ponderosa pine since fire exclusion and this has changed the natural (and desired) spatial pattern.

The dense, single-age forest structure combined with the lack of non-forested openings has affected function related to the presence of grass, forbs, and shrubs (vegetation composition and diversity). There is reduced understory productivity and function throughout the forest and within grasslands and meadows where trees have encroached. Ephemeral stream function has been affected by reduced ground cover, the presence of noxious weeds, tree encroachment, and the lack of fire. Spring function has been affected by drought, the lack of fire, and closed forest canopies, which increase evapotranspiration.

The existing forest structure has reduced forest health. This has affected resiliency or the ability of ponderosa pine to withstand natural disturbances including fire, insect and disease, and changing climatic conditions, such as drought. Over 200,000 acres (34 percent) are at risk from crown fire. Additional acres, primarily within or adjacent to Mexican spotted owl habitat are at risk from high intensity surface fire that can result in high-severity effects.

Approximately 71 percent of the ponderosa pine in the project area has a high hazard rating for bark beetle. About 34 percent of the ponderosa pine is moderately to heavily infected with dwarf mistletoe (see silviculture report). The current deficiency in resiliency is attributed to closed forest conditions and the associated buildup of forest fuels.

The project was posted in the Coconino NF and Kaibab NFs' schedule of proposed actions (SOPA) in January of 2011 and the notice of intent (NOI) to prepare an environmental impact statement was published in the Federal Register on January 25, 2011 (Vol. 76 FR 4279–4281). A draft proposed action was sent to a mailing list (hard copy and electronic mail) of 1,331 individuals, local government, State government, Federal and State agencies, and organizations. Fifty-four scoping responses (emails and letters) were received through May 5, 2011. A scoping report that included a summary of the scoping process was posted on the 4FRI Web site on June

29, 2011 (http://www.fs.usda.gov/4fri). In 2011, five public workshops were held during the informal scoping period, and two public meetings were held after the close of the scoping period. On March 11, 2011, the Arizona Game and Fish Department (AGFD) was designated a cooperating agency. The agency provided a habitat specialist to serve as an interdisciplinary team member and assist with the wildlife analysis.

A revised proposed action was sent to a mailing list of 213 parties (169 electronic mail and 44 hard copy recipients) and a second 14 day informal scoping period began with publication of a second revised NOI in the Federal Register on August 19, 2011 (Vol. 76 FR. 51936–51938). Less duplicates, 42 scoping responses (emails and letters) were addressed in content analysis.

Four key issues focused the analysis or drove alternative development:

- **Issue 1: Prescribed Fire Emissions**, was raised primarily by residents in the Verde Valley and Snowflake, Arizona, area. Residents are concerned that project emissions will degrade air quality. Degraded air quality would affect tourism, their quality of life, and their health. Social controversy related to this issue is centered on whether radioactive nuclides would be emitted when prescribed fire is used, creating additional health risks.
- **Issue 2: Conservation of Large Trees**, was specifically raised after the August 2011 revised proposed action excluded the stakeholder developed Large Tree Retention Strategy (LTRS). The LTRS represented social agreement between parties and was developed as a means to support landscape restoration and reduce conflict. The social controversy associated with this issue is that support for landscape-scale restoration may be withdrawn if the LTRS concepts are ignored.
- **Issue 3: Post-treatment Canopy Cover and Landscape Openness**, is an issue that reflects concerns related to conducting landscape restoration. The scale and intensity of the proposed restorative treatments would result in more lands being in an open condition. The treatments needed to provide for "openness" could increase the logging of mature and old trees and negatively affect wildlife, including goshawk and its prey species. Nonsignificant forest plan amendments (included in each action alternative) are needed to achieve desired conditions. The social controversy is a concern that National Forest Management Act (NFMA) requirements would not be met.
- **Issue 4: Increased Restoration and Research**, reflects recommendations to increase the acres of grassland restoration, include opportunities for wildlife and water yield research, increase habitat restoration in Mexican spotted owl habitat, and have treatments in alignment with the "Mexican Spotted Owl Recovery Plan, First Revision" (USDI 2012).

Other comments and recommendations (not considered key issues) were raised during the public workshops and/or submitted via email or letter. Many comments requested additional detail on what vegetation and prescribed fire treatments would look like once implemented. In response, a summary of design criteria complete with visuals was developed and included in the revised proposed action and an implementation plan was developed. Many commenters provided recommendations on identifying and prioritizing resources and infrastructure at risk from high-severity fire. This input was used to develop the initial prioritization and treatment location assessment matrix, which can be found in the project record. Stakeholders provided input on the use of the best available science and recommended additional literature references and citations. These changes were incorporated into the purpose and need. Another topic that emerged during scoping was the conservation of old trees. In response to recommendations, key concepts from the stakeholder-developed Old Tree Protection Strategy were incorporated into the purpose and need and all alternatives. Some comments were resolved by addressing the topic in environmental consequences. See the “Public Involvement” section (chapter 1) for additional information and the 2011 scoping report for the complete evaluation of comments and responses.

Alternatives

Five alternatives were considered but eliminated from detailed study (see chapter 2) and four alternatives were evaluated in detail (see table 1 and chapter 2). The alternatives evaluated in detail include:

- **Alternative A** is the no action alternative as required by 40 CFR 1502.14(c). There would be no changes in current management and the forest plans would continue to be implemented. Alternative A is the point of reference for assessing action alternatives B–D.
- **Alternative B** is the **proposed action.** This alternative would mechanically treat 388,489 acres of vegetation and utilize prescribed fire on 587,923 acres. It incorporates comments and recommendations received during 8 months of collaboration with individuals, agencies, and organizations. It proposes mechanically treating up to 16-inch d.b.h. in 18 Mexican spotted owl (MSO) protected activity centers (PACs) and includes low severity prescribed fire within 72 MSO PACs, including 56 core areas. Three nonsignificant forest plan amendments on the Coconino NF and two nonsignificant forest plan amendments on the Kaibab NF would be required to be in compliance with the plans (see table 2).
- **Alternative C** is the **preferred alternative.** This alternative would mechanically treat 434,001 acres of vegetation and utilize prescribed fire on 593,211 acres. It responds to Issue 2 (conservation of large trees) and Issue 4 (increased restoration and research). It adds acres of grassland treatments on the Kaibab NF, incorporates wildlife and watershed research on both forests, and mechanically treats and uses prescribed fire within the proposed Garland Prairie Research Natural Area on the Kaibab NF. It proposes mechanically treating up to 18-inch d.b.h. in 18 MSO PACs and includes low severity prescribed fire within 72 MSO PACs, including 56 core areas. Key components of the stakeholder created Large Tree Retention Strategy are incorporated into the alternative’s implementation plan. Three nonsignificant forest plan amendments on the Coconino NF and three nonsignificant amendments on the Kaibab NF would be required to be in compliance with the plans (see table 2).
- **Alternative D** would mechanically treat 388,489 acres of vegetation and utilize prescribed fire on 178,790 acres. This alternative was developed in response to Issue 1, Prescribed Fire Emissions. It decreases the acres that would receive prescribed fire by 30 percent when compared to alternative B (proposed action). It proposes mechanically treating up to 16-inch d.b.h. in 18 Mexican spotted owl (MSO) protected activity centers (PACs) but the PACs would not be treated with prescribed fire. Three nonsignificant forest plan amendments on the Coconino NF and two amendments would be required on the Kaibab NF to be in compliance with the plans (see table 2).

Actions Common to Alternatives (B–D)

- All action alternatives (B–D) propose additional actions including restoring springs and ephemeral channels, constructing protective fencing in select aspen stands, constructing (and decommissioning) temporary roads, reconstructing and improving roads, relocating a minimal number of road miles, and decommissioning existing roads and unauthorized routes (table 1).
- On those acres proposed for prescribed fire, two fires would be conducted over the 10-year period.
- Design features, best management practices (BMPs), and mitigation to be used as part of alternatives B–D are located in appendix C.
- All action alternatives incorporate key components of the Old Tree Protection Strategy into the alternative's design features (appendix C), implementation plan (appendix D), and monitoring and adaptive management plan (appendix E). The Forest Service worked collaboratively with stakeholders to develop the monitoring and adaptive management and implementation plan.
- All action alternatives include adaptive management actions that would be taken as needed to restore springs, ephemeral channels, and naturalize decommissioned and unauthorized roads (see table 16 in chapter 2).
- All action alternatives address Issue 3, post-treatment canopy cover and landscape openness. Alternatives B–D are designed to meet canopy cover in VSS 4 to VSS 6 in compliance with the forest plans, with the exception of those acres treated for an open reference condition (savanna). Each alternative addresses the interrelationship between canopy cover and old and large trees.

Table 1. Summary of alternatives analyzed in detail

Proposed Activity	Alternative A (No Action)	Alternative B (Proposed Action)	Alternative C (Preferred)	Alternative D
Vegetation Mechanical Treatment (acres)	0	388,489	434,001	388,489
Prescribed Fire (acres)*	0	587,923	593,211	178,790
MSO PAC Habitat Treatments	NA	Mechanically treat up to 16-inch d.b.h. in 18 PACs (excluding core areas) Utilize prescribed fire in 72 MSO PACs (excluding core areas)	Mechanically treat up to 18-inch d.b.h. in 18 PACs Utilize prescribed fire in 56 MSO PACs (including core areas) Utilize prescribed fire in 16 MSO PACs (excluding core areas)	Mechanically treat up to 16-inch d.b.h. in 18 PACs (excluding core areas) Utilize prescribed fire in 72 MSO PACs (excluding core areas)

Proposed Activity	Alternative A (No Action)	Alternative B (Proposed Action)	Alternative C (Preferred)	Alternative D
Springs Restored (number)	0	74	Same as alternative B	
Springs Protective Fence Construction (miles)	0	Up to 4	Same as alternative B	
Aspen Protective Fencing (miles)		Up to 82	Same as alternative B	
Ephemeral Stream Restoration (miles)	0	39	Same as alternative B	
Temporary Road Construction and Decommission (miles)	0	517	Same as alternative B	
Road Reconstruction/ Improvement (miles)	NA	Up to 30	Same as alternative B	
Road Relocation (miles)	NA	Up to 10	Same as alternative B	
Existing Road Decommission (miles)	NA	770	Same as alternative B	
Unauthorized Route Decommission (miles)	NA	134	Same as alternative B	

*On those acres proposed for prescribed fire, two fires would be conducted over the 10-year period.

Table 2. Summary of forest plan amendments by alternative and theme

Forest Plan Amendment Theme: Management in MSO Habitat						
Alternative	**Mechanical Treatments in PACs – CNF Only**	**Treatments in PAC Core Areas – CNF Only**	**Restricted Habitat Management – KNF Only**	**Basal Area in Restricted Target and Threshold Habitat – CNF and KNF**	**Population and Habitat Monitoring – CNF and KNF**	**Habitat Treatment in Incremental Percentages**
A	NA	NA	NA	NA	NA	NA
B	Coconino NF Amendment 1 Allows mechanical treatment up to 16-inch d.b.h. in 18 PACs	NA	Coconino NF Amendment 1 Kaibab NF Amendment 2: Adds definitions for target and threshold habitat, allows managing for less than 10% target or threshold habitat	NA—basal area in restricted target and threshold habitat remains 150 on both forests	Coconino NF Amendment 1 Kaibab NF Amendment 2 Defers monitoring to the project's U.S. Fish and Wildlife Service (FWS) biological opinion	Coconino NF Amendment 1 Kaibab NF Amendment 2: Defers treatment design to the project's FWS biological opinion
C	Coconino NF Amendment 1 Allows mechanical treatment up to 18-inch d.b.h. in 18 PACs	Coconino NF Amendment 1 Allows prescribed fire in 56 core areas	Coconino NF Amendment 1 Kaibab NF Amendment 3: Adds definition of restricted and threshold habitat, allows managing for less than 10% target or threshold on Coconino NF and Kaibab NF	Coconino NF Amendment 1 Kaibab NF Amendment 3 Allows for managing 6,321 acres on the Coconino NF and 2,090 acres on the Kaibab NF of restricted target and threshold habitat for a range of 110 to 150 BA	Coconino NF Amendment 1 Kaibab NF Amendment 3 Defers monitoring to the project's FWS biological opinion	Coconino NF Amendment 1 Kaibab NF Amendment 3: Defers treatment design to the project's FWS biological opinion

Forest Plan Amendment Theme: Management in MSO Habitat						
Alternative	**Mechanical Treatments in PACs – CNF Only**	**Treatments in PAC Core Areas – CNF Only**	**Restricted Habitat Management – KNF Only**	**Basal Area in Restricted Target and Threshold Habitat – CNF and KNF**	**Population and Habitat Monitoring – CNF and KNF**	**Habitat Treatment in Incremental Percentages**
D	Coconino NF Amendment 1 Allows mechanical treatment up to 16 inch d.b.h. in 18 PACs	NA	Coconino NF Amendment 1 Kaibab NF Amendment 2: Adds definitions for target and threshold habitat, allows managing for less than 10% target or threshold habitat on the Coconino NF and Kaibab NF	NA—basal area in restricted target and threshold habitat remains 150 on both forests	Coconino NF Amendment 1 Kaibab NF Amendment 1 Defers monitoring to the project’s FWS biological opinion	Coconino NF Amendment 1 Kaibab NF Amendment 2: Defers treatment design to the project’s FWS biological opinion

Alternative	Description
Forest Plan Amendment Theme: Management of Canopy Cover and Ponderosa Pine with an Open Reference Condition within Goshawk Habitat on the Coconino NF and Kaibab NF	
A	NA
B–D	Coconino NF Amendment 2 and Kaibab NF Amendment 1: (1) adds the desired percentage of interspaces within uneven-aged stands to facilitate restoration; (2) adds the interspace distance between tree groups; (3) adds language clarifying where canopy cover is and is not measured; (4) allows 29,017 acres on Coconino NF (alts B-D) and 27,637 acres on Kaibab NF (Alts B, D), 27, 675 acres (Alt C only) to be managed for an open reference condition (up to 90 percent open with less than 3 to 5 reserve trees); and (5) adds a definition to the forest plan glossary for the terms: interspaces, open reference condition, and stands.
Forest Plan Amendment Theme: Management of the Proposed Garland Prairie Research Natural Area on the Kaibab NF (Only)	
A	NA
B	NA

Alternative	Description
C	Kaibab NF Amendment 2: The amendment would add language to allow prescribed fire and mechanical treatments in order to maintain and/or restore the ecological qualities of the proposed research natural area.
D	NA
Forest Plan Amendment Theme: Effect Determination for Cultural Resources on the Coconino NF (Only)	
A	NA
B–D	Coconino NF Amendment 3: The amendment deletes the standard that would require achieving a “no effect” determination and adds the words “or no adverse effect” to the remaining standard. In effect, management strives to achieve a “no effect” or “no adverse effect” determination.

Major Conclusions

To varying degrees, all action alternatives meet forest structure and pattern, forest health, and vegetation composition and diversity elements of the purpose and need by:

- Improved representation in the grass/forb/shrub, seedling/sapling, mature, and old structural stages, and trending toward a balance of structural stages;
- Attaining a mosaic of interspaces and tree groups on 41 to 44 percent of treatment acres;
- Creating landscape heterogeneity (while still meeting fire behavior objectives) with alternative C providing the highest percentage (17 percent) of closed canopy conditions;
- Reducing stand density below the density related mortality zone (less than 56 percent of maximum stand density index (SDI) in all goshawk habitat and in restricted MSO habitat;
- Reducing the percentage of the landscape with a high bark beetle hazard rating (reduced from 83 percent (alternative A) to a range of 26 to 45 percent) resulting in increased resiliency to future attacks;
- Reducing the trajectory of dwarf mistletoe infection from intensifying and spreading (alternative A) to a lower rate of spread in alternatives B, C, and D;
- Reducing the potential for crown fire below 10 percent;
- Promoting vegetation composition and diversity with alternatives B and D improving the most large oak (84,177 acres);
- Creating and enhancing grassland inclusions in over 300,000 acres of MSO and goshawk habitat;
- Moving historic grasslands toward desired conditions with alternative C moving the most (11,230) acres; and
- Improving soil condition and function, and protecting soil productivity and watershed function.

In alternative A, over 200,000 acres (34 percent of the project area) would continue to have the potential for high-severity fire effects from crown fire. In alternatives B, C, and D, the potential for high-severity effects from crown fire in the project area would be reduced to approximately 23,000 to 41,000 acres (4 to 7 percent). In the short term (2020), all action alternatives would move toward desired conditions for fire regime condition class (FRCC) at the project area scale. However, in the long term (2050), over 50 percent of the project area in alternative D would revert to FRCC 3, resembling current conditions.

All action alternatives would cause soil disturbance and erosion rates below tolerance level and would improve herbaceous understory productivity and nutrient cycling. Soil productivity and soil and watershed function would move toward desired conditions. There is a risk of severe soil effects from fire in alternative A. All action alternatives propose to use prescribed fire at different levels that would comply with Arizona Department of Environmental Quality (ADEQ) requirements. Emissions from the action alternatives are lower than predicted under a wildfire scenario in alternative A.

All action alternatives provide and sustain long term MSO nesting and roosting habitat and reduce the risk of high severity wildland fire and other natural disturbances. For management indicator species (MIS), alternative A has the potential to decrease the quantity and quality of the habitat (fire risk) and decrease the population trend in the long term as canopies close, understory production decreases, and Gambel oak is shaded out from pine. Alternatives B, C, and D may increase the quality and quantity of the habitat and increase the population trend. However, for Abert's squirrel (Coconino NF) and the tassel-eared squirrel (Kaibab NF), there may be a short-term decrease in habitat quantity and quality and population trend that changes to increasing in the long term. There would be no measurable negative effects to migratory bird populations, and habitats for which important bird areas (IBAs) were established would benefit from alternatives B, C, and D.

Overall, alternative A would not prevent, delay, or decrease the predicted effects of climate change. Forest density would continue to increase, heightening the risk of stand density and insect and disease related mortality. The ponderosa pine forest would have limited resilience to survive and recover from potential large-scale impacts. Alternatives B and C affect fire behavior, forest structure, and forest health, and increase resilience to natural disturbances associated with climate change on over 500,000 acres in both the short and long term. Alternative D increases forest resiliency to large-scale impacts (including climate) in the short term. In the long term, however, over 300,000 acres would return to pretreatment conditions and would be susceptible to high-severity surface effects, which equates to reduced resiliency to natural disturbances.

In alternative A, carbon stocks would remain high. In a current management scenario, large-scale fire events would release significant amounts of carbon into the atmosphere. In alternatives B, C, and D, individual tree growth would improve, resulting in larger average trees size and increased carbon storage over time, offsetting short-term losses of carbon removed through the mechanical thinning.

Decision Framework

The Coconino and Kaibab NF supervisors are the Forest Service officials responsible for deciding whether to select the actions as proposed (alternative B), select one of the other action alternatives including alternative C and alternative D, select an alternative that combines attributes from the alternatives or another variation, or, select no action (alternative A). Their decision includes determining: (1) the location and treatment methods for all restoration activities; (2) design criteria, mitigation, and monitoring requirements; (3) the components that will be included in the monitoring and adaptive management plan; (4) the components that will be included in the implementation checklist and plan; (5) the estimated products or timber volume to make available from the project; and (6) whether the forest plans will be amended.

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List of Acronyms

4FRI	Four-Forest Restoration Initiative
ACHP	Advisory Council on Historic Preservation
ADEQ	Arizona Department of Environmental Quality
ADGF	Arizona Department of Game and Fish
APE	Area of potential effect
APIF	Arizona Partners in Flight
ATV	All-terrain vehicle
AUM	Animal unit month
ADGF	Arizona Game and Fish Department
BA	Basal area
BAER	Burned Area Emergency Response
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BE	Biological evaluation
BMP	Best management practice
BSTR	Breeding season timing restriction
CBD	Canopy bulk density
CBH	Canopy base height
CCF	Hundred cubic feet
CEQ	Council on Environmental Quality
CFLR	Collaborative Forest Landscape Restoration
CFLRP	Collaborative Forest Landscape Restoration Program
CFR	Code of Federal Regulations
CHU	Critical habitat unit
CNF	Coconino National Forest
CO	Carbon monoxide
CWD	Coarse woody debris
CWPP	Community wildfire protection plan
d.b.h.	Diameter at breast height
DEIS	Draft environmental impact statement
dPFA	Dispersal post-fledgling area
d.r.c.	diameter at root collar
EIS	Environmental impact statement
EMA	Ecosystem management area
EO	Executive Order
EPA	Environmental Protection Agency
ERT	Emission reduction techniques
FAAWN	Forest attributes and wildlife needs
FEIS	Final environmental impact statement
FLEA	Flagstaff/Lake Mary Ecosystem Analysis
FRCC	Fire regime condition class

FSH	Forest Service Handbook
FSM	Forest Service Manual
FVS	Forest Vegetation Simulator
GA	Geographic area
GFFP	Greater Flagstaff Forest Partnership
GIS	Geographic information system
GPS	Global positioning system
HCI	Habitat capability indices
HUC	Hydrologic unit code
IBA	Important Bird Areas
IDT	Interdisciplinary team
IMPLAN	Impact Analysis for Planning
IT	Intermediate thin
KNF	Kaibab National Forest
LANL	Los Alamos National Laboratory
LMR	Lake Mary Region
LOPFA	Landscapes outside post-fledgling area
LTIP	Large tree implementation plan
LTRS	Large tree retention strategy
LUZ	Land use zones
MA	Management area
MAUM	Thousand animal unit month
MMBF	Million board feet
MBF	Thousand board feet
MIS	Management indicator species
ML	Maintenance level
mph	Miles per hour
MRNG	Management Recommendations for the Northern Goshawk in the Southwestern United States
MSO	Mexican spotted owl
MSO PAC	Mexican spotted owl protected activity area
NAAQS	National Ambient Air Quality Standards
NACOG	Northern Arizona Council of Governments
NEPA	National Environmental Policy Act
NF	National forest
NFMA	National Forest Management Act
NHPA	National Historic Preservation Act
NMED	New Mexico Environment Department
NO2	Nitrogen dioxide
NOGO	Northern goshawk
NOI	Notice of intent
NVUM	National Visitor Use Monitoring

O2	Ozone
OGP & LTRS	Old growth protection and large tree retention strategy
OTIP	Old tree implementation plan
PA	Participating agreement
PAC	Protected activity center
PFA	Northern goshawk post-fledgling family area
PIF	Partners in Flight
PJ	Pinyon-juniper
PM	Particulate matter
PNVT	Potential natural vegetation type
PPC	Potential plant community
QMD	Quadratic mean diameter
RAP	Roads analysis process
RNA	Research natural area
ROD	Record of decision
ROS	Recreation opportunity spectrum
ROW	Right-of-way
RU	Restoration uunit
RVD	Recreation visitor day
SDI	Stand density index
SHPO	State Historic Preservation Office
SI	Stand improvement
SIO	Scenery integrity objectives
SMS	Scenery Management System
SO2	Sulfur dioxide
SOPA	Schedule of proposed actions
SPCC	Soil prevention control and countermeasures
SSM	Single sample maxim
SU	Subunit
SUDS	Special Uses Database System
TAP	Travel analysis process
TCP	Traditional cultural properties
TES — soils term	Terrestrial ecosystem survey
TES species —biological term	Threatened, endangered and sensitive species
TM	Travel management
TMR	Travel Management Rule
TNC	The Nature Conservancy
TPA	Trees per acre
UEA	Uneven-aged
UGM	Upper Gila Mountain
UGM RU	Upper Gila Mountain Recovery Unit
USDA	United States Department of Agriculture

USDI	United States Department of the Interior
UTV	Utility task vehicle
VMS	Visual Management System
VQO	Visual quality objectives
VSS	Vegetation structural stages
WCF	Watershed condition framework
WEPP	Water Erosion Prediction Project
WFLC	Western Forest Leadership Coalition
WFUD	Wildlife fish user day
WUI	Wildland-urban interface

Chapter 1 – Purpose of and Need for Action

Introduction

We have prepared this draft environmental impact statement (DEIS) to comply with the National Environmental Policy Act (NEPA), National Forest Management Act (NFMA), and other relevant Federal and State laws and regulations. The direct, indirect, and cumulative environmental impacts to the biological, physical, and social resources that may occur from implementing restoration activities are disclosed in this DEIS.

This document is organized as follows:

> **Chapter 1. Purpose of and Need for Action:** The chapter includes information on the history of the project proposal, the purpose of and need for the project, and our proposal for achieving the purpose and need. This section also details how we informed the public, how the public responded, and how collaboration was used to develop the proposal.
>
> **Chapter 2. Alternatives, Including the Proposed Action:** This chapter provides a more detailed description of our proposed action, how the action alternatives were developed, as well as alternative methods considered for achieving the stated purpose. This section also provides a summary table of the environmental consequences associated with each alternative.
>
> **Chapter 3. Affected Environment and Environmental Consequences:** This chapter describes the current condition and predicted environmental effects of accomplishing 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, individuals, and agencies consulted during development of the environmental impact statement.
>
> **Glossary:** This section provides an explanation of terms and acronyms used in the document.
>
> **References:** This section provides a list of scientific literature used to inform the analysis.
>
> **Appendix:** The appendix consists of multiple parts and provides detailed information to support the analysis: a placeholder for a map packet (appendix A); proposed forest plan amendments (appendix B); project design features, best management practices (BMPs), and mitigation (appendix C); the implementation plan (appendix D); the monitoring and adaptive management plan (appendix E); cumulative effects (appendix F); and wildlife bridge habitat analysis (appendix G).
>
> **Index:** The index provides page numbers by document topic.

Additional documentation, including the complete analysis for each resource, may be found in the project record located at the Coconino National Forest Supervisor's Office, 1824 South

Thompson Street, Flagstaff, Arizona. All specialist reports are also posted on the 4FRI Web site at: http://www.fs.usda.gov/4fri.

Project Overview

The Four-Forest Restoration Initiative (4FRI) is a planning effort designed to restore ponderosa pine forest resiliency and function across four national forests in Arizona including the Coconino, Kaibab, Apache-Sitgreaves, and Tonto (figure 1).

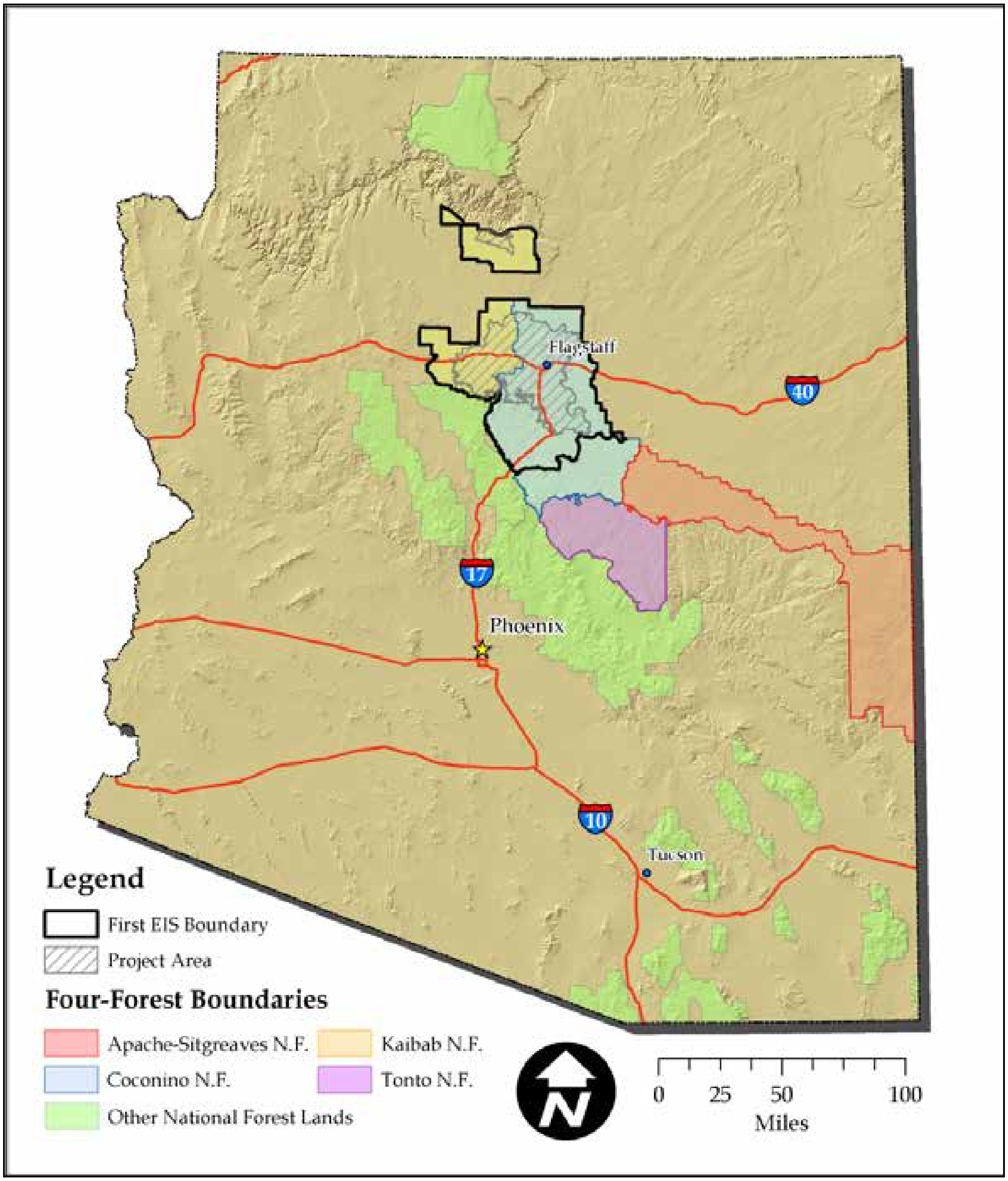

Figure 1. Four-Forest Restoration Initiative (4FRI) vicinity map

The EIS project boundary is approximately 988,674 acres and includes the Coconino National Forest (hereafter referred to as Coconino NF) and Kaibab National Forest (hereafter referred to as Kaibab NF) (figure 2). This analysis is independent of any preceding or subsequent environmental analysis that may occur across northern Arizona.

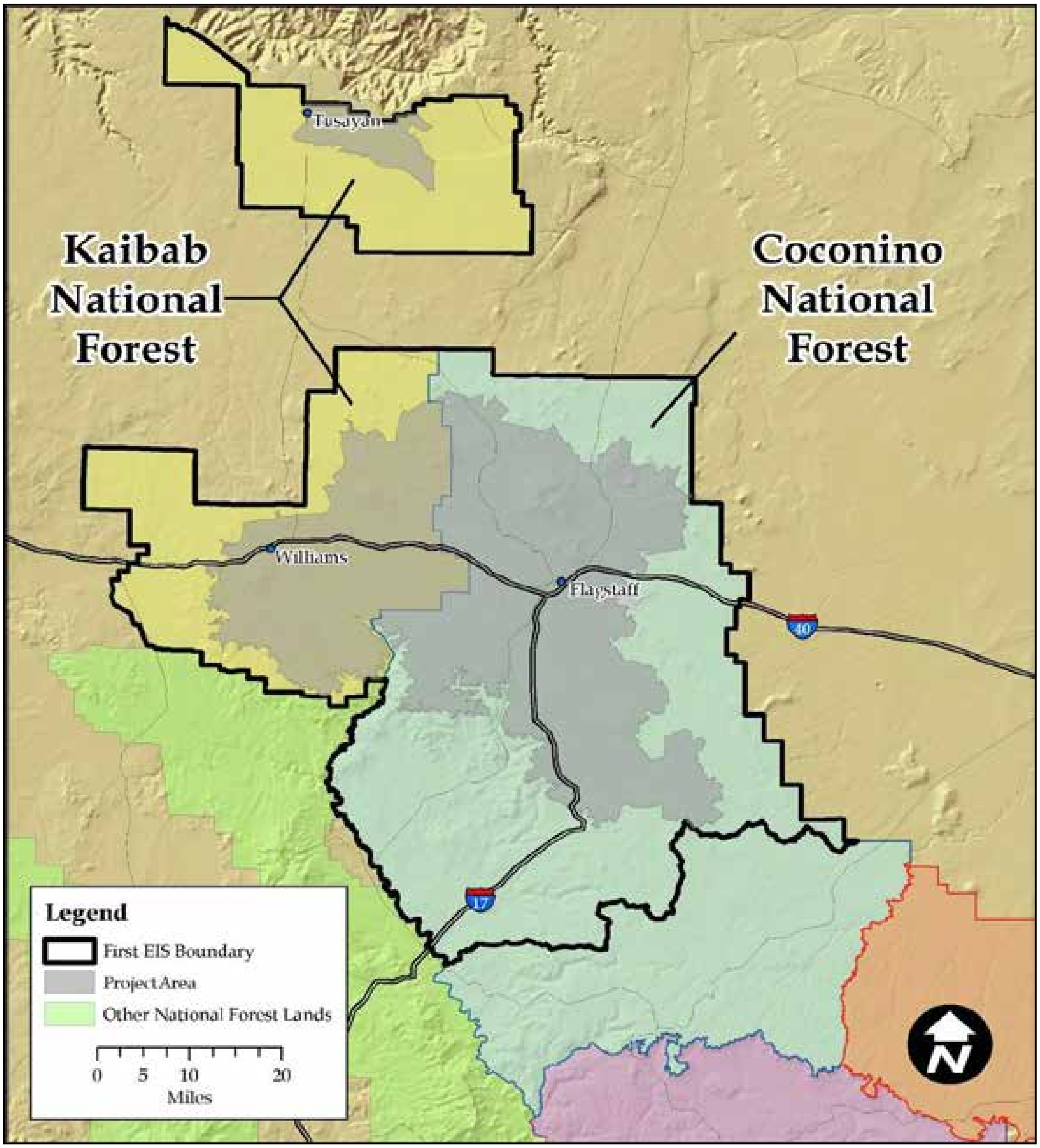

Figure 2. EIS project boundary on the Coconino and Kaibab National Forests

The Forest Service is proposing to conduct restoration activities on approximately 587,923 acres of the Coconino NF and Kaibab NF. Of this total, approximately 356,115 acres would be treated on the Coconino NF and 231,809 acres would be treated on the Kaibab NF. Restoration actions would focus on the Flagstaff district with fewer acres included on the Mogollon Rim and Red

Rock districts of the Coconino NF. On the Kaibab NF, activities would occur on the Williams and Tusayan districts (figure 3).

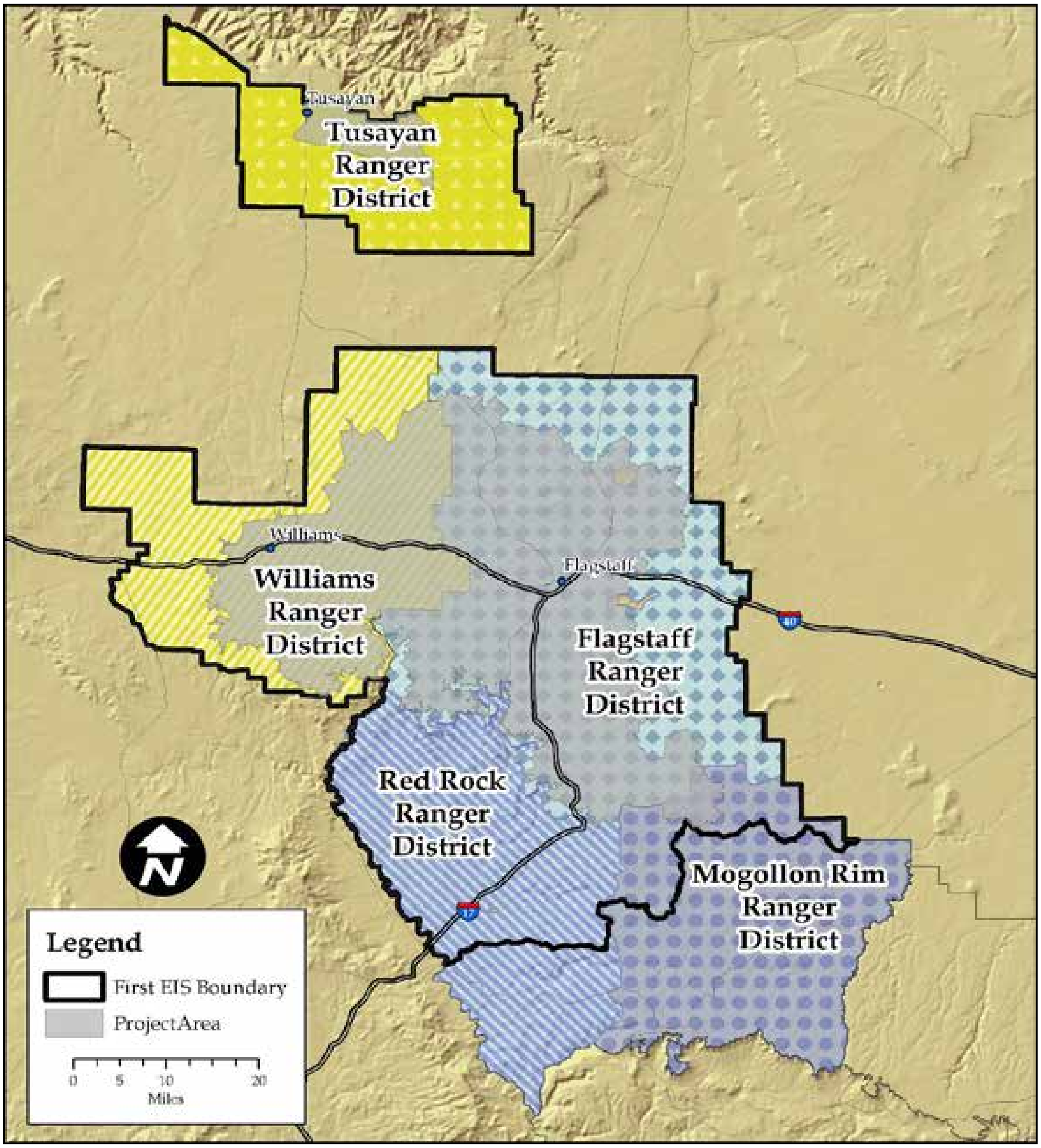

Figure 3. Coconino NF and Kaibab NF ranger districts within the project area

Project Location

Within the 988,764-acre project area, approximately 380,000 acres were excluded from this proposal. Excluded areas include about 204, 957 acres that are being analyzed in separate environmental analyses; approximately 30,000 acres that are located in special areas that include designated wilderness, inventoried roadless areas, wild and scenic rivers, and wilderness study areas; and over 145,000 acres that are non–Forest Service administered lands. The project area is entirely located within Coconino County.

Due to the size of the project area, the Forest Service utilized a strategy developed by the 4FRI stakeholders and stratified the landscape into six restoration units (figure 4). A restoration unit (RU) is a contiguous geographic area that ranges from about 46,000 acres to 333,000 acres in size.

RU 1 includes portions of the Flagstaff, Mogollon, and Red Rock districts (Coconino NF). RU 1 is generally located south of I-40 and east of I-17. RU 3 includes portions of the Williams district (Kaibab NF), Flagstaff, and Red Rock districts (Coconino NF) and is generally located south of I-40 and west of I-17. RU 4 includes portions of the Flagstaff district and Williams district. It is generally located north of I-40 and west of Highway 180.

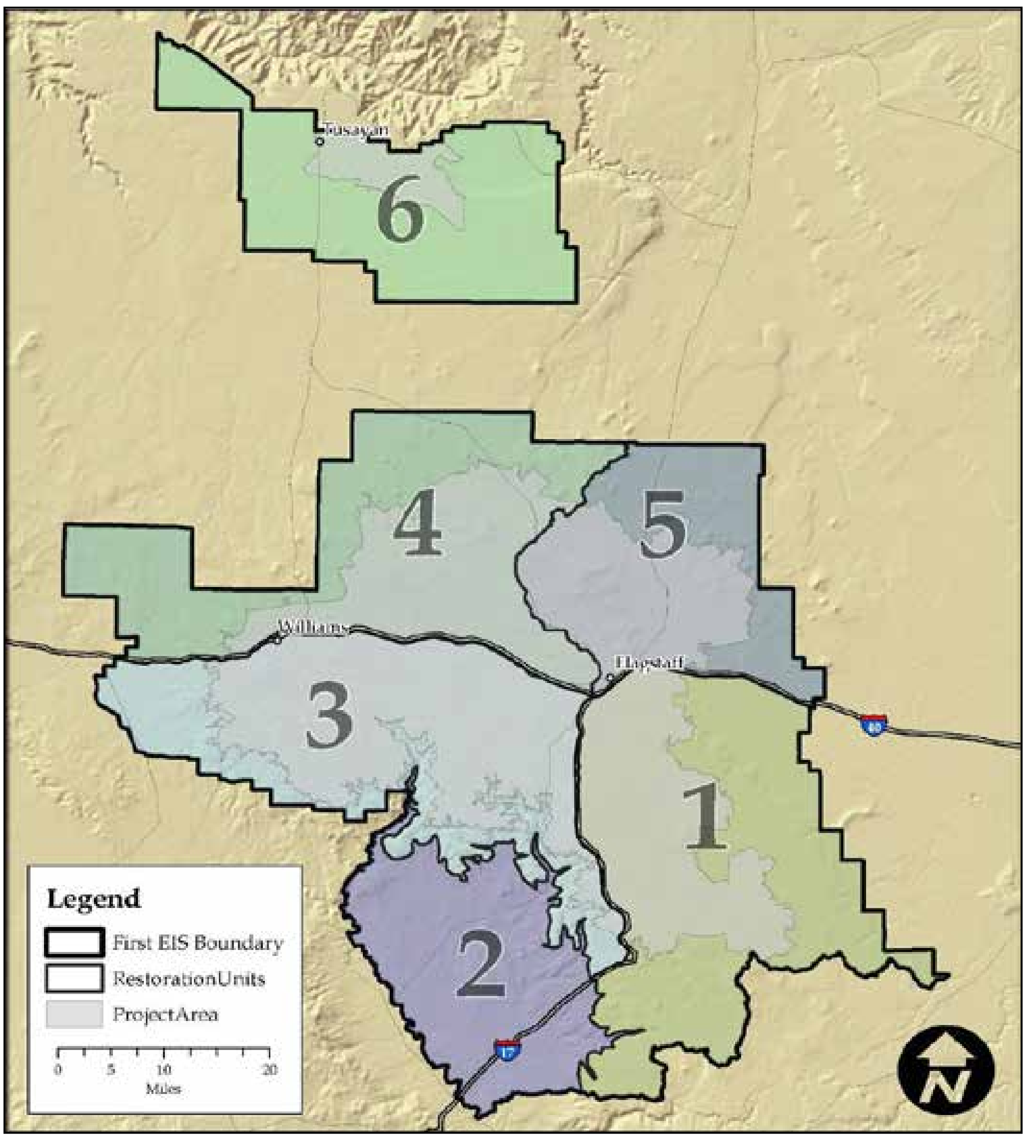

Figure 4. Restoration units (RU) within the project area

Communities in the vicinity of the proposed treatments include Flagstaff, Munds Park, Mormon Lake, Tusayan, and Williams, Arizona. RU 5 is located north of I-40 and east of Highway 180 and includes landmarks such as Mount Elden. RU 6 lies immediately south of, and adjacent to, Grand Canyon National Park. RU 6 entirely encompasses the Tusayan district on the Kaibab NF. RU 2 is located west of I-17 and south of the Mogollon Rim (see figure 4). RU 2 was removed from this analysis because the vegetation is not contiguous pine.

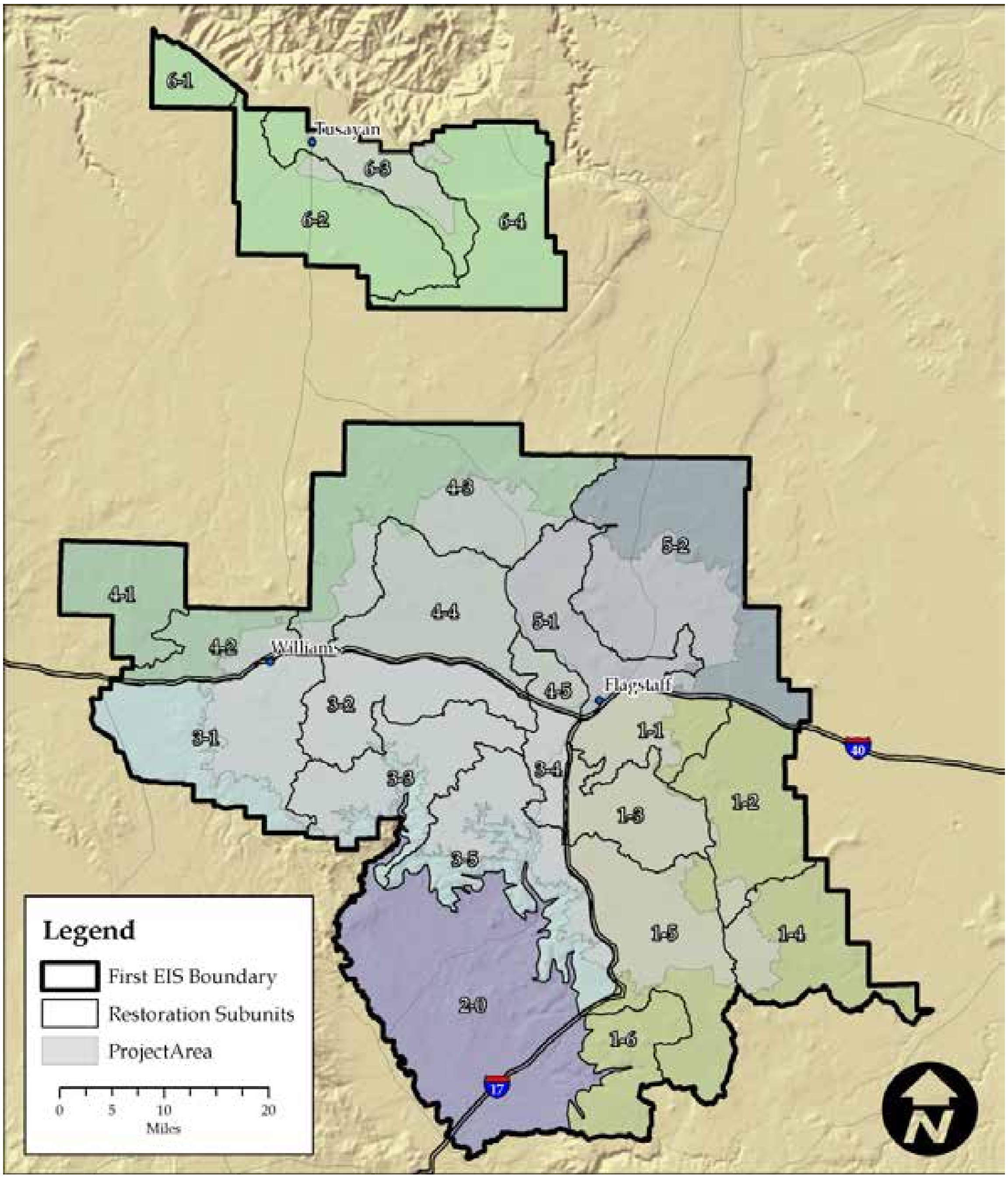

Figure 5. Restoration subunits within the project area

The project area was further stratified into several subunits that range from 4,000 to 109,000 acres in size (figure 5). Both units (RU and subunits) are based on 6^{th} code watershed boundaries, State and forest transportation systems, and the forest's administrative boundaries. Each resource specialist determined how best to use the restoration units and subunits in their analysis. Some analysis scales were selected to meet forest plan requirements (see individual resource sections in chapter 3).

4FRI Background

The 4FRI proposal is a result of several years of planning and collaboration among interested parties, groups and organizations, and Federal, State, and local government agencies. The focus has been to restore forest landscapes and reduce the potential for severe fire effects in a manner that benefits the local economy. In 2007, the Arizona Forest Health Council completed the "Statewide Strategy to Restore Arizona's Forests." The strategy's vision integrates knowledge and experience from science, community collaboration, and economics to identify the necessary steps to increase the rate and effectiveness of forest restoration across Arizona.

The communities that surround the four national forests engaged in the 4FRI project are economically and social diverse. Apache, Coconino, Gila, Graham, Navajo, and Yavapai Counties have economic bases in consumptive industries, agriculture, tourism, and services to retirees. With this diversity has come an increasingly divergent vision of how to manage public lands and how to respond to the threat of uncharacteristic wildland fires. While the stakeholders may not always agree, there is strength in having stakeholders who can provide a wide range of potential solutions when working with the Forest Service.

In February 2008, based on recommendations within the statewide strategy, the "Analysis of Small Diameter Wood Supply in Northern Arizona" (Hampton et al. 2008) report was completed. This process demonstrated a level of "social agreement" on how much, where, and under what basic parameters mechanical treatment, as one restoration tool, could be used to accelerate restoration of the 2.4 million-acre ecosystem. In 2008, the Kaibab NF launched the Kaibab Forest Health Focus, a science-based, collaborative effort to guide future landscape-level forest restoration efforts.

In order to further advance collaborative efforts and secure the necessary assistance, the Forest Service created a task force to work with the Forest Health Council. The purpose of the task force was to identify alternative approaches to accelerating forest restoration in northern Arizona. In order to move into on-the-ground implementation as quickly as possible, stakeholders representing individuals, State and Federal agencies, local governments, the four national forests in northern Arizona, and the Forest Service's Southwestern Regional Office moved forward with the four-forest initiative. The initiative received funding via the CFLR Act in 2010.

4FRI History
Statewide Strategy to Restore Arizona's Forests (2007)
Analysis of Small Diameter Wood Supply in Northern Arizona (2008)
Kaibab Forest Health Focus (2008)
Collaborative Forest Landscape Restoration Fund (CFLR) (2009)
Landscape Restoration Strategy For The First Analysis Area (2010)

In 2009, Title IV of the Omnibus Public Land Management Act authorized funding for the Collaborative Forest Landscape Restoration Fund (CFLR) to support landscape-scale restoration on National Forest System lands. CFLR objectives include reducing uncharacteristic wildfire and the associated management costs, supporting local and collaborative partnerships, supporting monitoring of restoration efforts, and supporting efforts that utilize forest products that benefit communities and offset treatment costs.

Also in 2010, stakeholders began refining their vision for ponderosa pine forest restoration. Stakeholders developed a comprehensive landscape restoration strategy for the Coconino NF and Kaibab NF, which documented existing conditions, potential treatment areas, and desired post-treatment conditions. The Forest Service used the stakeholder's "Landscape Restoration Strategy for the First Analysis Area" report (4FRI Stakeholders 2010) to inform the purpose and need and proposed action for this project.

While the 4FRI analysis has been in development, other broad-scale planning efforts have been underway. The Forest Service requires that forest plans for individual forests be revised every 10 to 15 years. The Coconino NF forest plan was issued in 1987 and the Kaibab NF forest plan was issued in 1988. Although the plans are 24 to 25 years old, Congress has provided exemptions for older plans. The efforts to revise these plans began in 2006. The Kaibab NF issued their draft EIS and forest plan in April of 2012, with a final revised plan expected in late spring of 2013. The Coconino NF is scheduled to release their draft documents in the spring of 2013, with an expected final to follow a year later. This 4FRI draft EIS is consistent with the current forest plans as amended, including the project specific amendments proposed in appendix B of this document. Since the draft 4FRI and plan revision documents have been developed essentially concurrently, consistent coordination and a great deal of alignment exists between the desired conditions and drivers of the three efforts. The timing of the release of the final documents will determine the description of how the 4FRI will achieve the consistency requirements. To the extent there is any inconsistency with a current or revised plan adopted prior to the final decision on the 4FRI project, appropriate project specific plan amendments consistent with those proposed in appendix B of this document will be made at the time of the final decision.

Likewise, the Mexican spotted owl (MSO) recovery plan has been undergoing revision. The original MSO recovery plan was issued in 1995. After years of experience with implementation, the need to improve the MSO recovery plan was recognized by the FWS. The "Mexican Spotted Owl Recovery Plan, First Revision" (USDI 2012) was released in December 2012. While the current DEIS addresses the recommendations of the 1995 MSO recovery plan, it also has been developed with continuous coordination with the FWS and is in alignment with the final MSO recovery plan.

Project Record

All documents used in the decisionmaking process for this project are in the project record located at the Coconino National Forest Supervisor's Office and most are available for public review.

Purpose and Need for Action

The purpose and need for proposing an action was determined by comparing the objectives and desired conditions in the Coconino NF and Kaibab NF land and resource management plans (forest plans) to the existing conditions related to forest resiliency and forest function. Where plan information was dated or not explicit, local research and the best available science were utilized. The results of the comparison are displayed in narrative, tables, and photographs in this chapter.

The purpose of the project is to reestablish and restore forest structure and pattern, forest health, and vegetation composition and diversity. There is a need to increase forest resiliency and sustainability, protect soil productivity, and improve soil and watershed function. Resiliency increases the ability of the ponderosa pine forest to survive natural disturbances such as fire, insect and disease, and climate change (FSM 2020.5). The project is expected to move almost 600,000 acres toward comprehensive, landscape-scale restoration with benefits that include improved forest function and health, vegetation biodiversity, wildlife habitat, soil productivity, watershed function, and reduced risk of severe fire effects.

Existing and Desired Conditions

Forest Structure and Spatial Pattern

This analysis utilizes canopy density and openness, the relationship of vegetation structural stage (VSS) to age/size class and diversity, stand density and key habitat components, and old growth as criteria to describe existing and desired conditions for forest structure and spatial pattern in the project area.

Tree Density and Canopy Openness

A characteristic of historic Southwest ponderosa pine forests was the grass/forb/shrub (interspace) interspersed among small groups of trees. This interspace typically comprised a large portion of the landscape (Woolsey 1911, Cooper 1960, White 1985, Pearson 1950, Covington et a1. 1997, Abella and Denton 2009). Low-severity fires occurred every 2 to 22 years and maintained an open canopy structure (Weaver 1951, Cooper 1960, Swetnam 1990, Swetnam and Baison 1990, Fulé et al. 1997a, Covington et al. 1997, Heinlein et al. 2005, Fulé et al. 2003). Typical historical tree groups ranged from 0.1 to 0.75 acre in size and comprised 2 to 40 plus trees per group (White 1985, Fulé et al. 2003, Covington et al. 1997). Others have described historical ponderosa pine forests as having low tree density, open, savanna-like stands consisting of groups of pine trees interspersed with grassy or shrubby openings (White 1985). For this analysis, the term "openness" is used to convey the percentage of the forested area that is grass/forb/shrub interspace. It is often used interchangeably with the term "canopy density.".

In contrast to having a ponderosa pine ecosystem consisting of groups of trees mixed with interspaces, approximately 74 percent of the ponderosa pine forest type within the project area is departed from historical reference conditions[1]. Table 3 displays the existing percent of interspace (openness) in the project area by restoration unit[2]. Openness (percent of interspace) ranges from very open/open to closed. Stand data was used to generate figure 6.

[1] Reference condition is defined as the condition due to site, ecology, and natural disturbance regime.

[2] Determining openness is best accomplished thru aerial imagery analysis. At present, this sort of analysis is only available for a small portion of the project area. In the absence of a detailed aerial imagery analysis, we determined that stand data was an appropriate substitute to classify the continuous canopy conditions that currently exist within the project area. Therefore, the current openness within the project area was determined using the canopy density measurements described in the silviculture specialist report (see page 33 and table 10).

Table 3. Canopy openness (classification percent of interspace) by restoration unit

Restoration Unit	Acres	Very Open/Open (%)	Moderately Closed (%)	Closed (%)	Unknown (%)
1	145,793	14	28	58	1
3	129,225	13	25	60	2
4	134,301	22	34	39	4
5	61,671	55	24	10	11
6	41,188	30	40	29	2
All ponderosa pine	**512,178**	**22**	**29**	**45**	**3**

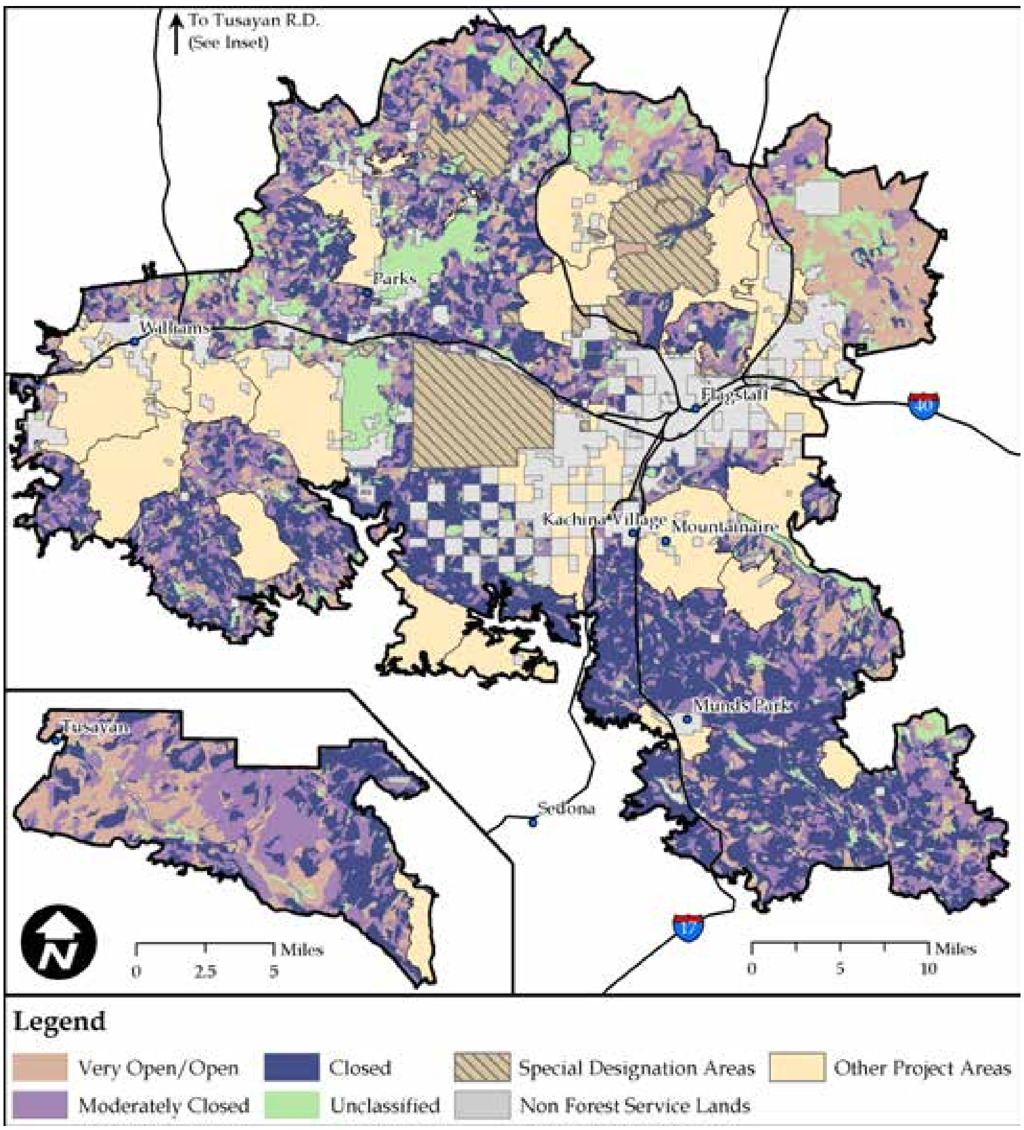

Figure 6. Existing canopy openness within the project area

Overall, the desired condition is to reestablish non-forested openings that have been invaded by ponderosa pine since fire exclusion and reconfigure the forests toward their natural spatial pattern. At the fine scale, groups of trees would typically range from 0.1 acre to 1.0 acre in size. Tree group size would exceed 1 acre as needed to respond to site-specific conditions including the presence of presettlement trees or mature and mid-aged trees that are developing old tree characteristics. Tree groups in the mid-age and older structural stages (VSS 4, 5, and 6) would have canopies that provide moderate to closed conditions and where canopies are touching, or nearly touching, in order to provide connectivity for wildlife that are dependent on this type of habitat.

There would be a mix of very open, open, moderately closed, and closed canopy conditions at the landscape (ponderosa pine vegetation) scale. Moderate to closed canopy conditions would be widely distributed on the landscape. Habitat for goshawk and MSO, steep slopes, and buffers for resources such as bald eagle roosts, other raptor nests, caves, and special designations that would not be treated (including wilderness and most research natural areas) provide connectivity with moderate to closed canopy conditions. At the landscape scale (extent of ponderosa pine vegetation), openness would range from very open (up to 90 percent) within the savanna and grassland matrix to closed (as low as 10 percent) on the highly productive forest areas to achieve a heterogeneous condition across the landscape.

There is a need to use management strategies that move tree group pattern, interspaces, and canopy density toward the natural range of variability (sum of reference conditions) and provide a mix of open, moderately closed, and closed canopy conditions at the fine (group) to landscape (ponderosa pine vegetation) scale. There is a need to amend the forest plans to provide for grass/forb/shrubs (interspace) interspersed among tree groups.

Vegetation Structural Stage (VSS) – Age and Size Class Diversity

Vegetation structural stage (VSS) is a method of describing forest age and tree size from seedling to old forests. The VSS classification is based on the tree size class with the highest square foot of basal area and is an indication of the dominant tree diameter distribution. A group of trees with a single age class is considered even-aged while a group of trees with multiple age classes is uneven-aged.

Figure 7. Even-aged forest structure common throughout the project area

Forest resiliency and diversity is dependent on the distribution of age and size classes and the capacity of an area. Currently, over 50 percent of the forested acres in the project area lacks age and size class diversity and is in an even-aged structure. This has resulted in a homogenous landscape with reduced resiliency. Reduced resiliency is expressed as the increased potential for severe effects from wildfire, increased stand density related mortality, reduced resiliency to bark beetle attack, increased dwarf mistletoe spread, and reduced understory productivity. Figure 7 displays a dense, even-aged forest structure that is common throughout the project area.

Goshawk Habitat

The project area has approximately 369,033 acres of goshawk habitat outside of post-fledgling family areas (PFA). Forest plan direction for lands outside post-fledgling family areas (LOPFA) is to have uneven-aged conditions with a diversity of VSS distributed across the landscape (see table 4). Diversity in age and size classes (VSS) represents specific habitat components that are needed for goshawk prey species. An imbalance potentially decreases the ability of goshawks to maintain their numbers over time.

Even-aged stand conditions occur on approximately 46 percent of the LOPFA habitat with approximately 54 percent in uneven-aged stand conditions (see silviculture report, table 80). Although the uneven-aged stand condition partially meets forest plan direction, the desired balance of VSS classes is lacking as displayed in table 4. In all stands, the young and mid-aged forest structural stages are surplus, and the grass/forb/shrub, seedling/sapling, mature, and old forest stages are deficit relative to forest plan direction. The desired condition is to move even-aged stands to an uneven-aged structure and move all stands toward the forest plan's VSS percent distribution.

Table 4. Existing VSS distribution within goshawk LOPFA

Vegetation Structural Stage (VSS)	Tree Diameter (d.b.h.*)	Even-Aged Stands Existing Percent of Area	Un-even Aged Stands Existing Percent of Area	Forest Plan Desired VSS Percent Distribution
1 – Grass/Forb/Shrubs	0.0 – 0.9″	8	0	10
2 – Seedling/Sapling	1.0 – 4.9″	0	2	10
3 – Young Forest	**5.0 – 12″**	**36**	**35**	20
4 – Mid-age Forest	**12.0 – 17.9″**	**47**	**32**	20
5 – Mature Forest	18.0 – 23.9″	8	14	20
6 – Old Forest	24″+	1	17	20

*diameter at breast height

Forest Structure – Post-fledgling Family Areas (PFA)

There is approximately 30,600 acres of goshawk PFA habitat in the project area. PFAs consist of nest sites and adjacent habitat most likely to be used by fledglings during their early development. This category also includes dispersal PFAs (or dPFA) which is unoccupied suitable habitat within a 2 to 2.5-mile range of a PFA.

Almost 90 percent of PFAs are even-aged stands dominated by the young and mid-aged forest structural stages with very little representation of the other structural stages. VSS 3 and 4 are overrepresented and VSS 1, 2, 5, and 6 are deficit (table 5). Outside of nest stands, the desired condition is to have an uneven-aged forest structure that represents all age classes (USDA 1987, USDA 1988).

Table 5. VSS distribution within goshawk PFA habitat

Vegetation Structural Stage (VSS)	Tree Diameter (d.b.h.*)	Even-Aged Stands Percent of Area	Uneven-aged Stands Percent of Area	Forest Plan Desired Percent Distribution
1 – Grass/Forb/Shrubs	0.0 – 0.9″	3	0	10
2 – Seedling/Sapling	1.0 – 4.9″	1	1	10
3 – Young Forest	**5.0 – 12″**	**35**	**34**	20
4 – Mid-age Forest	**12.0 – 17.9″**	**52**	**39**	20
5 – Mature Forest	18.0 – 23.9″	8	15	20
6 – Old Forest	24″+	1	11	20

*d.b.h. is diameter at breast height

Stand Density and Key Habitat Components

One of the major factors affecting forest structure and development is inter-tree competition. High forest densities result in increased inter-tree competition. Measures of forest density include basal area, trees per acre, and stand density index (SDI). Basal area (BA) is the cross-sectional area of all trees, measured in square feet per acre, and trees per acre (TPA) are simply a count of the total number of trees on an acre. SDI is a relative measure of stand density based on the number of trees per acre and the mean diameter (Reineke 1933). It is a good indicator of tree competition. Based upon established forest density/vigor relationships, density-related mortality from competition begins to occur once the forest reaches 45 to 50 percent of maximum stand density. Mortality is likely to occur at density levels over 60 percent of maximum stand density (Long 1985).

Table 6 displays that both SDI and BA are above the desired condition, which means much of the goshawk habitat is currently at risk from density-related mortality. The table also displays existing and desired conditions for snags and coarse woody debris (CWD), two key components of wildlife habitat. The project area is deficit in snags and does not meet desired conditions for CWD. The desired condition is to reduce the potential for density-related mortality and have stand densities at levels that facilitate forest health. Stand densities allow for overall forest development, tree vigor, and resilience to characteristic disturbances. In addition to stand density, there is a need to move toward forest plan desired conditions for snags and coarse woody debris.

Table 6. Existing and desired conditions for goshawk habitat components

Habitat Type and Acres	BA Average		SDI % of Maximum		Snags >18″ d.b.h. per Acre		CWD Total Tons per Acre	
	Existing	Desired	Existing	Desired	Existing	Desired	Existing	Desired
PFA (30,600)	107	70–80	45	25–40	0.4	2.0	3.9	5–7
LOPFA (369,033)	96	50–70	40	15–35	0.4	2.0	3.5	5–7

Mexican Spotted Owl (MSO) Habitat

Forest Structure, Stand Density, and Key Habitat Components

Table 7 displays the existing and desired conditions for structural attributes and habitat components within MSO habitats. The components (which include SDI, TPA, CWD, and snags) are indicators of nest/roost characteristics as outlined in the forest plans. These components are necessary to maintain a suite of prey species for MSO.

Based upon established forest density/vigor relationships, density related mortality begins to occur once the forest reaches 45 to 50 percent of maximum stand density, and mortality is likely at density levels over 60 percent of maximum stand density (Long 1985). Table 7 displays that all MSO habitats exceed the 60 percent-plus maximum stand density. In all MSO habitats, trees greater than 18-inch d.b.h. and large snags are deficit from forest plan and MSO recovery plan desired conditions[3] and CWD requirements are met on less than 10 percent of the habitat.

The desired condition is to improve the quality of MSO nesting and roosting habitat by reducing the potential for density related mortality and moving toward forest plan desired conditions for trees greater than 18-inch d.b.h., snags, and CWD. There is a need to implement uneven-aged management strategies that improve nesting and roosting habitat and reduce the potential loss of habitat. There is a need to amend the Coconino NF forest plan to allow treatments that would most effectively improve nesting and roosting habitat.

Table 7. Existing and desired habitat components within MSO habitats

Habitat Type	BA		SDI (% of Maximum)		Trees 18″+ (per Acre)		Snags 18″+ (per Acre)		CWD >12″[4] (Tons per Acre)	
	Existing	Desired	Existing	Desired	Existing	Desired	Existing	Desired	Existing	Desired
Restricted Target/ Threshold (8,713 acres)	162	150–170	85	≤55	16.3	≥20	0.5	≥2.0	1.2	≥1
Restricted Other (67,378 acres)	137	70–90	69	25–40	11.5	≥20	0.4	2.0	0.5	≥1
Protected (36,455 acres)	155	NA	78	≤55	14.9	NA	.6	≥2.0	0.8	≥1

Forest Structure – Old Growth

Old growth guidelines for both forests state, “All analyses should be at multiple scales—one scale above and one scale below the ecosystem management areas” (USDA 1987, USDA 1988). Given

[3] No specific desired conditions exist for snags in the 12-inch to 18-inch category in MSO habitat.

[4] A ponderosa pine log 8 feet long and 12 inches in diameter, as described in the forest plans, is about 1/3 of 1 ton. Managing for greater than a ton should, on average, meet forest plan requirements.

the size of this project, scales of analysis based on existing divisions of the landscape developed specifically for this project were utilized. The smallest scale is represented at the stand level with stands averaging less than 100 acres in size. The ecosystem management area (EMA) is the restoration subunit. Subunits range in size from 4,000 to 109,000 acres. The scale above the EMA is the restoration unit, which ranges in size from 46,000 to 335,000 acres.

There are approximately 512,178 acres of ponderosa pine in the project area. Of this total, 194,804 acres (38 percent) are the closest to meeting old growth conditions. Currently, all restoration units meet or exceed the 20 percent minimum forest plan requirement. Table 8 displays ponderosa pine old growth allocations by restoration unit/forest for all the ponderosa pine within the 4FRI analysis area as well as ponderosa pine within other areas within the project area that were analyzed in separate vegetation analysis (see silviculture area of analysis discussion).

Old growth allocations are based on current conditions within the project area along with forest plan specific management direction. Most sites currently do not fully meet the minimum criteria for old growth conditions as listed in the forest plans. However, the habitat types noted below are closest to meeting old growth conditions. This approach is consistent with forest plan direction, which states: “strive to create or sustain as much old growth compositional, structural, and functional flow as possible over time at multiple-area scales…and seek to develop or retain old-growth function on at least 20 percent of the naturally forested area by forest type in any landscape” (USDA 1987, USDA 1988).

The old growth allocation acreage/percentage for ponderosa pine includes 100 percent of MSO protected habitat, 100 percent of MSO target/threshold habitat, 40 percent of MSO restricted habitat that is uneven-aged with low dwarf mistletoe infection, and 80 percent of MSO restricted habitat that is even-aged and mid-aged to old with low dwarf mistletoe infection. In goshawk habitat, the old growth allocation acreage/percentage for ponderosa pine includes 100 percent of goshawk nest stands, 40 percent of goshawk PFA and foraging areas that are uneven-aged with low dwarf mistletoe infection, and 80 percent of goshawk PFA and foraging areas that are even-aged and mid-aged to old with low dwarf mistletoe infection.

Table 8. Ponderosa pine old growth allocation acres and percent by forest and restoration unit

RU	Ponderosa Pine Total Acres (4FRI/Other Projects) Total		Ponderosa Pine Old Growth Acres (4FRI/Other Projects) Total		Old Growth Percent (%)	
	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF
1	(145,793/46,952) 192,745	NA	(65,189/11,130) 76,319	NA	40	NA
3	(58,327/29,176) 87,503	(70,898/57,886) 128,784	(21,341/10,894) 32,235	(25,177/13,746) 38,923	37	30

RU	Ponderosa Pine Total Acres (4FRI/Other Projects) Total		Ponderosa Pine Old Growth Acres (4FRI/Other Projects) Total		Old Growth Percent (%)	
	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF
4	(56,981/5,941) 62,922	(77,320/14,089) 91,409	(17,718/1,965) 19,683	(30,342/2,140) 32,482	31	36
5	(61,671/40,686) 102,357	NA	(24,745/7,469) 32,214	NA	31	NA
6	NA	(41,188/7,450) 48,638	NA	(10,291/1,490) 11,781	NA	24
Total	(322,772/122,755) **445,527**	(189,407/79,425) **268,832**	(128,994/31,458) **160,452**	(65,810/17,376) **83,186**	**36**	**31**

There are approximately 23,316 acres of pinyon-juniper within the 4FRI project area and approximately 6,218 acres of pinyon-juniper that have been allocated in other vegetation analyses. The old growth allocation in pinyon-juniper totals 29,534 acres (table 9) and includes those sites/acres that are closest to the minimum criteria for old growth conditions (per the forest plan). The allocation equates to 68 percent on the Coconino NF and 58 percent on the Kaibab NF.

Table 9. Pinyon-juniper old growth allocation acres and percent by forest

RU	Ponderosa Pine Total Acres (4FRI/Other Projects) Total		Ponderosa Pine Old Growth Acres (4FRI/Other Projects) Total		Old Growth Percent (%)	
	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF
1	(1,141/2,135) 3,276	NA	(611/447) 1,058	NA	32	NA
3	(832/0) 832	(3,201/3,533) 6,734	(356/0) 356	(1,747/2,245) 3,992	43	59
4	(42/0) 42	(7,123/0) 7,123	(42/0) 42	(4,116/0) 4,116	100	58
5	(8,771/0) 8,771	NA 0	(7,302/0) 7,302	NA 0	83	NA
6	NA	(2,206/550) 2,756	NA	(1,452/110) 1,562	NA	57
Total	(10,786/2,135) 12,921	(12,530/4,083) 16,613	(8,311/447) 8,758	(7,315/2,355) 9,670	68	58

Figure 8 displays the general locations of ponderosa pine and pinyon-juniper in the project area that are closest to meeting old growth conditions. In both ponderosa pine and pinyon-juniper, the desired condition is to allocate sites that best meet old growth conditions and manage those sites toward old growth structural attributes. Where management occurs within ponderosa pine and pinyon-juniper cover type, there is a need to maintain the old growth characteristics within the sites allocated as old growth.

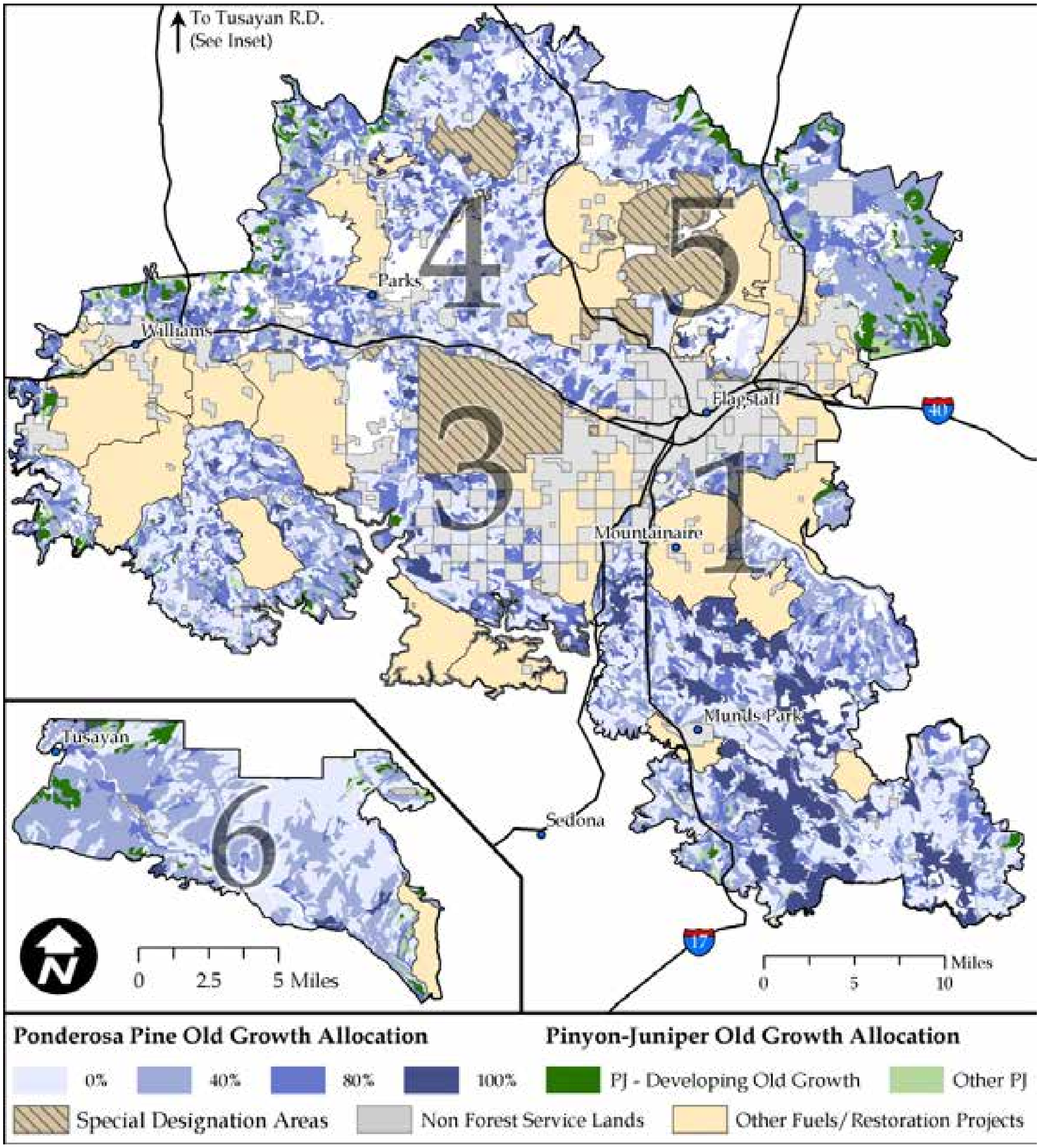

Figure 8. Ponderosa pine and pinyon-juniper stands that best meet old growth conditions

Forest Health – Insect and Disease

Bark Beetle

Forest health is defined by the vigor and condition of the forest stands (see previous discussion on stand density) and the presence of insects and disease that affect the sustainability of the forest.

Ponderosa pine is attacked and killed by several different bark beetles in the genera *Dendroctonus* and *Ips*. Approximately 8 percent of the ponderosa pine analysis area has a low bark beetle hazard rating, while 21 percent of the area has a moderate rating, and the remaining 71 percent has a high bark beetle hazard rating (table 10). Areas with a low or moderate hazard rating would be expected to be resistant to successful bark beetle attack and large-scale mortality.

Table 10. Existing ponderosa pine beetle hazard rating (percent of area in each RU)

Hazard Rating	RU 1	RU 3	RU 4	RU 5	RU 6	Analysis Area Acres/Percent of Total
Low	3	6	8	25	0	38,903/8
Moderate	12	11	27	46	25	106,734/21
High	85	83	64	29	75	366,542/71

Dwarf Mistletoe

Dwarf mistletoe infection in ponderosa pine is common throughout the project area. Mistletoe infected trees slowly weaken, experience growth loss, and eventually die (Lynch et al. 2008).

Approximately 66 percent of the area is not infected or has a low infection level (with less than 20 percent of the trees infected). Thirty-four percent of the area is moderately infected (20 to 50 percent of the trees infected) or heavily infected (50 to 80 percent of the ponderosa pine infected). The average range of infection is from 4 to 10 percent in the none/low infection level group and 33 to 42 percent in the moderate/high infection level group (table 11). Several stands have an extreme infection rating where 80 percent or more of the trees are infected.

Table 11. Existing dwarf mistletoe infection level by restoration unit (RU)

Infection Level	RU 1	RU 3	RU 4	RU 5	RU 6	Percent of Analysis Area
None/Low – Percent of Area	52	57	73	91	82	66
None/Low –Average Percent Trees Infected	5	6	4	10	5	6
Moderate/High –Percent of Area	47	43	26	9	18	34
Moderate/High – Average Percent Trees Infected	37	33	38	41	42	36
Extreme – Percent of Area	1	<1	<1	0	0	<1
Extreme – Average Percent Trees Infected	88	93	90	–	–	89

The desired condition is to move toward a forest structure that would allow beetles and dwarf mistletoe to function at naturally occurring or historic levels. There is a need to manage insect and disease in a manner that reduces, but does not eliminate bark beetle or dwarf mistletoe in order to provide nesting, resting, foraging, and catching sites for birds and mammals including Abert’s/tassel-eared squirrels.

Vegetation Diversity and Composition

Gambel Oak

Vegetation diversity throughout the project area has declined. Gambel oak, a subtype within ponderosa pine, is important to many wildlife species as it provides important nesting and foraging habitat. A lack of fire led to increased stand densities of pine and resulted in Gambel oak becoming overtopped by fast growing ponderosa pine (figure 9) (Abella and Fulé 2008). The desired condition is to develop and maintain a variety of oak size classes and forms where they occur. Oak should range from shrubby thickets and pole-sized clumps to large trees across the landscape in order to provide habitat for a large number and variety of wildlife species (Brown 1958, Kruse 1992, Rosenstock 1998, Abella and Springer 2008, Abella 2008a, Neff et al. 1979). There is a need to stimulate new growth, maintain growth in large diameter trees, and use management strategies that provide for a variety of shapes and sizes across the landscape.

Figure 9. Ponderosa pine overtopping of Gambel oak in the Bar-M (Coconino NF) portion of the project area

Aspen

Figure 10. Existing condition of aspen near Government Prairie, Kaibab NF

There are approximately 1,471 acres of aspen in the project area. Aspen is dying or rapidly declining on both forests due to the combined effects of conifer encroachment, browsing, insect, disease, severe weather events, and lack of fire disturbance (Lynch 2008) (USDA 2009, USDA 2008). A study by Fairweather et al. (2007) on the Coconino NF indicates that aspen on low elevation dry sites (less than 7,500 feet) has sustained 95 percent mortality since 2000. Mortality on these sites is expected to continue as many live trees currently have only 10 to 30 percent of their original crown. Figure 10 displays an unhealthy aspen stand within the project area. The desired condition is to maintain and/or regenerate aspen. Where possible, there is a need to stimulate growth and increase individual recruitment of aspen.

Grasslands

There are approximately 48,774 acres of montane/subalpine and Colorado Plateau/Great Basin grasslands within the project area. Only 2 percent of the Great Basin grasslands on the Coconino NF were historically comprised of very large shrubs, closed canopies, and very large trees. Currently, this percentage is 19 percent (USDA 2009). Within montane/subalpine grasslands, encroachment has increased from 0 to 33 percent (USDA 2009). Conifers on the Kaibab NF have invaded at least 8 percent of grasslands (USDA 2008).

Figure 11 and figure 12 display grassland encroachment within the project area over a 100-year period. On both forests, the desired condition for grasslands is to move toward the natural range of variability. Tree cover would range from 0 to 9 percent, grasses and forbs would dominate and fire return intervals would average 10 years (Weaver 1951, Cooper 1960, Swetnam 1990, Swetnam and Baison 1996, Fulé et al.1997a, Fulé et al.1997c, Heinlein et al. 2005, Diggins 2010). Fire would function within its natural fire regime across the landscape without causing loss to ecosystem function or to human safety, lives, and values. When fire does occur, it typically replaces more than 75 percent of the dominant vegetation type (USDA 2009). There is a need to reduce and/or remove tree encroachment, which has reduced the size and function of landscapes that were historically grasslands.

Figure 11. Fern Mountain (Hart Prairie) Grassland circa 1880s

Figure 12. Fern Mountain (Hart Prairie) Grassland circa 1980s

Pine-Sage

Based on review of the project area, ponderosa pine trees are encroaching and shading out the sage on about 5,261 acres. Without treatment, pine density is likely to increase and entirely shade out the sage component. The desired condition is to restore the historic pattern within the pine-sage mosaic and manage fire to enhance sage. There is a need to remove post-settlement pine that is currently overtopping and shading sage. Figure 13 displays the post-treatment desired condition. This figure portrays an area just south of the town of Tusayan, Arizona, approximately 6 years after a low severity prescribed fire.

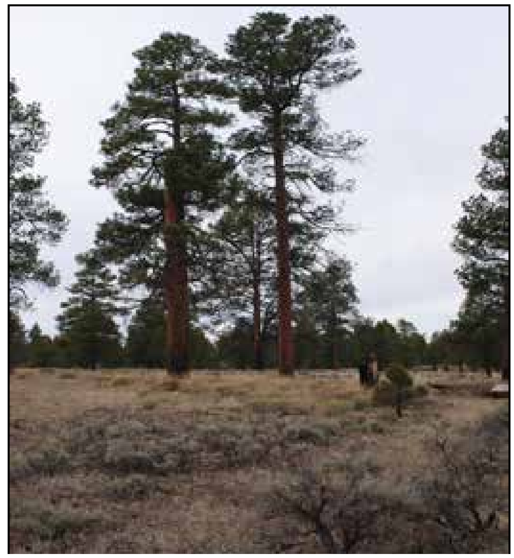

Figure 13. Post-treatment pine-sage desired condition (Kaibab NF)

Forest Resiliency

Fire Behavior

Currently, over 200,000 acres (34 percent) of the treatment area has crown fire potential. Crown fire generally produces 100 percent mortality in ponderosa pine by consuming the crowns of trees. Additional acres, primarily within or adjacent to MSO habitat, are at risk from high intensity surface fire that can result in high-severity effects. A high intensity surface fire burning through this area could scorch the canopy sufficiently to cause widespread mortality (Van Wagner 1973). Figure 14 displays the current crown and surface fire potential within the project area.

Wildland-urban interface (WUI) areas are spread across the project area and are located within or adjacent to the communities of Flagstaff (RU 1, 3, 4, 5), Williams (RU 3, 4), Tusayan (RU 6), Parks (RU 3, 4), Belmont (RU 3, 4), and scattered developments such as Doney Park (RU 5), Munds Park (RU 1), and Kachina Village (RU 3). Although past fuel treatments have been implemented in the WUI closest to the major population centers, much of the landscape is still vulnerable to fire or to second order fire effects such as flooding, erosion, weed infestations, and damaged infrastructure.

In addition to WUI, areas at risk include water resources, such as the Lake Mary, Rio de Flag, and Bill Williams watersheds. The Lake Mary and Rio de Flag watersheds are a source of water for the city of Flagstaff, Arizona. The Bill Williams watershed provides water for the city of Williams, Arizona. Other resources at risk from crown fire include a diverse assemblage of wildlife that are known to occur or have habitat within or adjacent to the project area. Figure 15 provides a visual comparison between fire risk and some (not all) at-risk resources. Figure 15 displays the location of some resources at risk including the city of Flagstaff, the town of Tusayan, other non–Forest Service lands, watersheds, and MSO PACs, for reference with figure 14, which displays fire potential.

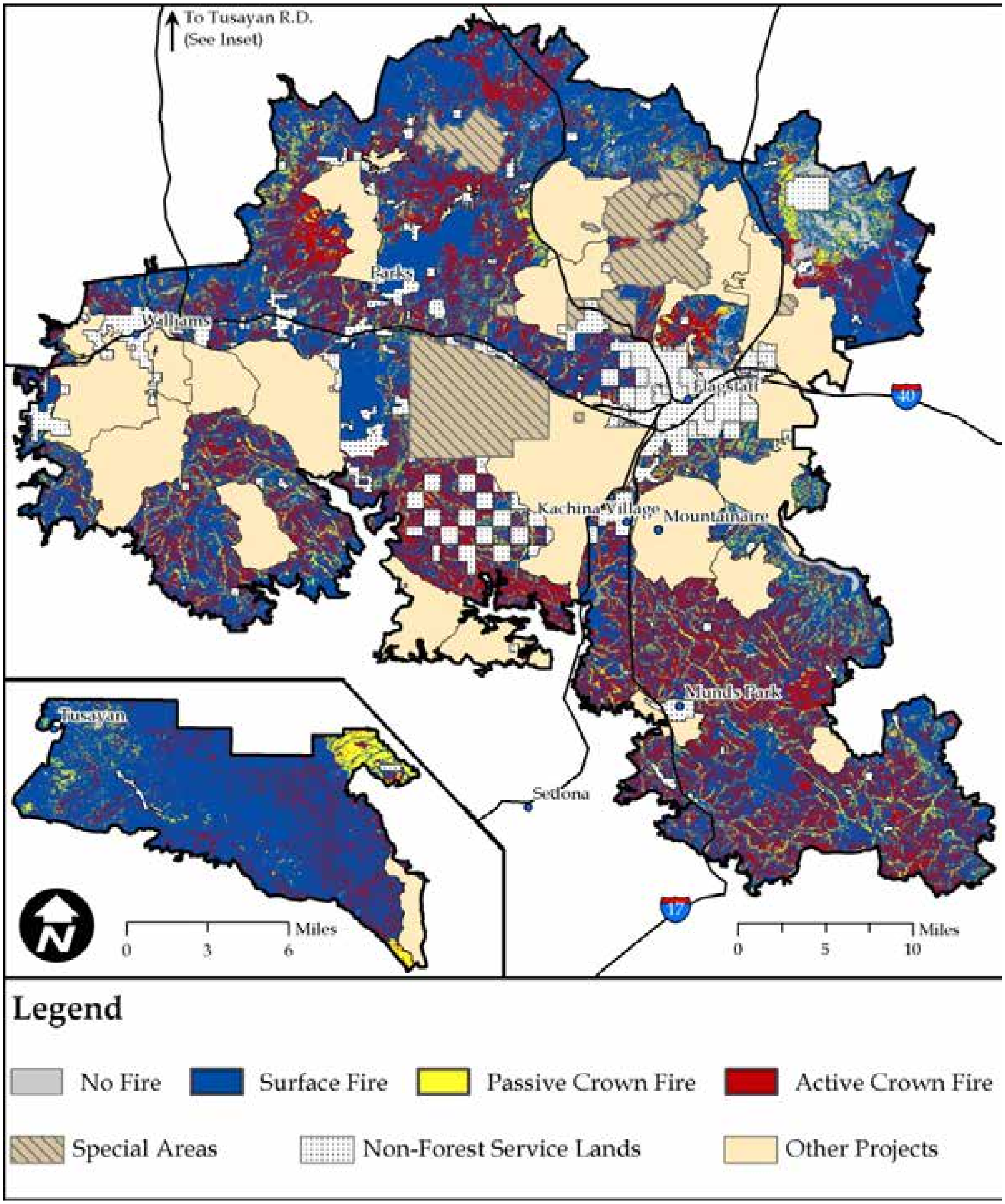

Figure 14. Current crown and surface fire potential in the project area

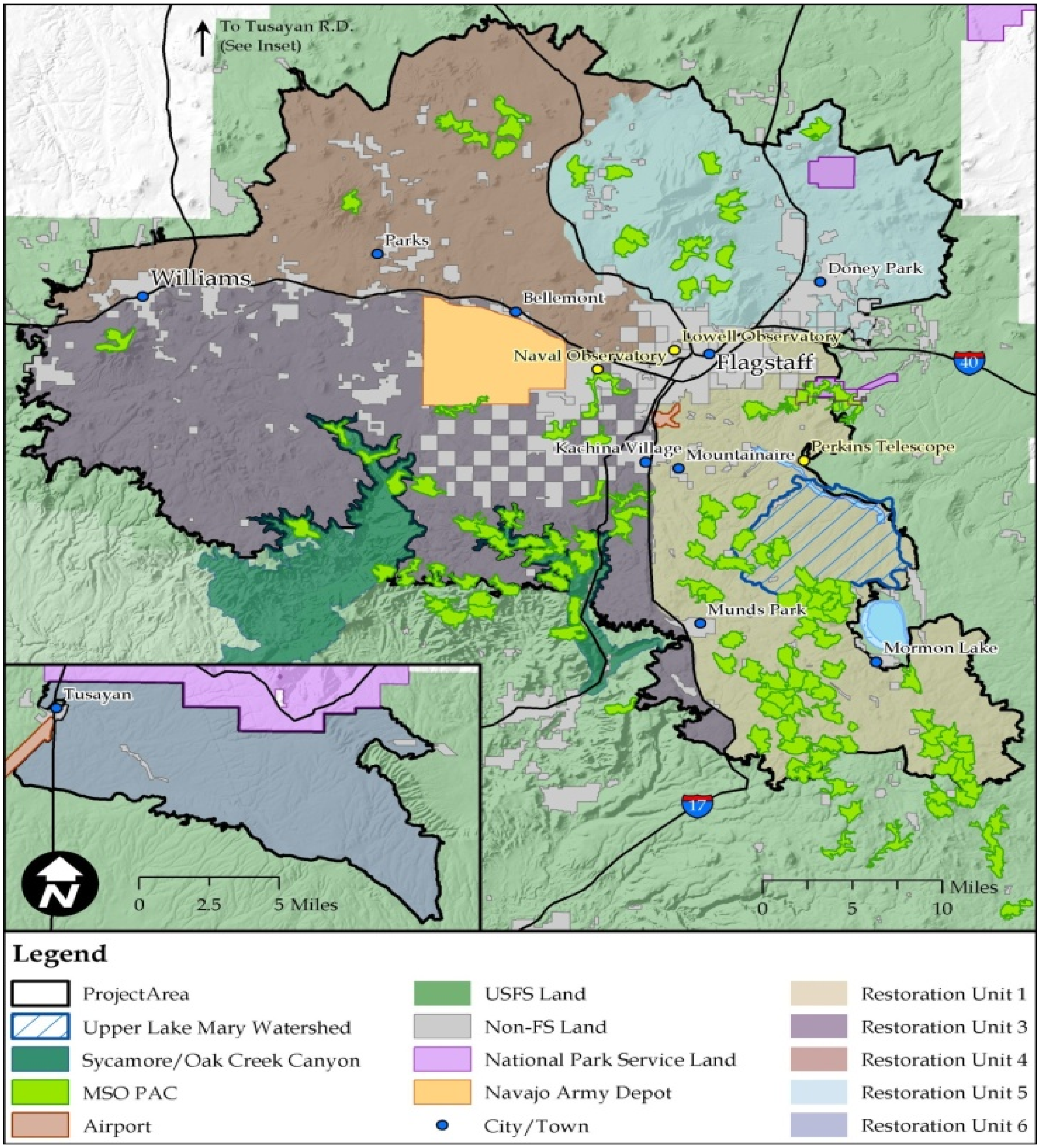

Figure 15. Locations of resources at risk (for reference with figure 14)

Canopy Characteristics and Surface Fuels Affecting Fire Behavior

Canopy bulk density and canopy base height are canopy characteristics used to measure the potential for crown fire. Higher canopy bulk densities means that fire can easily move through the crowns of trees. Higher canopy bulk densities means there are more fuels to burn. With more fuels, fire intensity would increase. Approximately 61 percent of the ponderosa pine in the project area has a canopy bulk density rating greater than 0.050 kilogram per cubic meter (kg/m3) . The desired condition in ponderosa pine to reduce the potential for crown fire is to have canopy bulk density below 0.050 kg/m3.

The canopy base height of a stand is the lowest height above the ground at which there is a sufficient amount of canopy fuel to spread fire vertically into the canopy (Scott and Reinhardt, 2001). The lower the canopy base height, the easier it is for crown fire to initiate (Van Wagner 1977). Currently, canopy base heights in the project area average approximately 15 feet. To minimize the potential for crown fire initiation, the desired condition is to have average stand canopy base height above 18 feet. Table 12 summarizes existing and desired conditions for fire risk.

Table 12. Existing and desired fire potential in ponderosa pine in the project area

Evaluation Criteria	Existing Condition	Desired Condition
Potential crown fire (%)	34	Up to 10
Canopy Base Height (ft.)*	15	>18
Canopy Bulk Density (kg/m3)*	0.061	<0.050
Potential surface fire (%)	64	Up to 90

*Stand average across the project area

Surface fuels (as analyzed for fire behavior and effects) include litter, duff, and CWD greater than 3-inch diameter. High surface fuel loading can result in high-severity effects because they can smolder in place for long periods, transferring more heat into soil and tree cambiums. Mechanical treatments generally do not remove surface fuels from a treatment area, so they remain a potential source of heat (fire effects) and emissions.

Currently, litter, duff, and CWD average 11 tons per acre. When averaged, the existing surface fuels do not exceed recommended surface fuel loading (Brown et al., 2003). However, there are areas that exceed desired surface fuel loadings. Most of these areas are near, or associated with, MSO habitat (see the fire ecology report).

Overall, the desired condition is to have fire maintain a mosaic of diverse native plant communities. In ponderosa pine, no more than 10 percent of the project area should be prone to crown fire under modeled conditions, with high severity acres spatially distributed (Swetnam and Baison 1996, Roccaforte et al. 2008). In grasslands, no more than 3 percent should be prone to crown fire. In this analysis, “crown fire” in grasslands is a reference to crown fire in trees growing in the grasslands. In both vegetation types, when crown fire does occur, it should be mostly passive crown fire, occurring in single trees, groups, clumps, or areas where there had been mortality (wind throw, insects, etc.). High intensity surface fire should be rare with surface fuel loadings (including CWD, litter, and duff) ranging between 5 and 20 tons per acre (Brown et al. 2003).

The desired condition is to have fire function as a natural disturbance within the ecosystem without causing loss to ecosystem function or to human safety, lives, and values. Over time, conditions would allow managers to use fire to maintain the area as a functioning ecosystem. There is a need to reduce canopy bulk density and raise canopy base height in order to reduce the potential for crown fire. In order to reduce the potential for high severity surface fire, there is a need to maintain surface fuel loadings that meet desired conditions and reduce excessive surface fuel loadings in areas adjacent to and within MSO habitat.

Fire Regime Condition Class

Fire regime condition class (FRCC) is a coarse-scale evaluation protocol developed to support planning and risk assessments (Schmidt et al. 2002, Hann et al. 2004). FRCC assessments determine how departed a landscape's fire regime is from its historic fire regime. It is scaled from 1 to 3, with 3 being the most departed and 1 being the least departed.

Approximately 59 percent of the project area is in condition class 3. This indicates the fire regime is significantly departed from historical ranges (table 13). In condition class 3, the risk of losing key ecosystem components is high. Approximately 27 percent of the project area is in FRCC 2, indicating the ecosystem is moderately departed from its historical range. The departure in fire frequency has resulted in dramatic alterations to fire size, intensity, severity, landscape patterns, and/or vegetation attributes.

The desired condition is to have 100 percent of the project area in FRCC 1. In FRCC 1, fire regimes would be within historical ranges and the risk of losing key ecosystem components would be low. Vegetation, fuels, and natural disturbances would be intact and functioning within historical ranges. There is a need to reduce the percent of the ponderosa pine and grassland vegetation in FRCC 2 and FRCC 3 and move the fire regimes toward FRCC 1.

Table 13. Existing and desired fire regime condition class ponderosa pine

Fire Regime Condition Class (FRCC)	Existing Condition (percent of total area)	Desired Condition (percent of total area)
FRCC 1	14	100
FRCC 2	27	0
FRCC 3	59	0

Soil Productivity and Watershed Function

Soils

Approximately 85 percent of soils and strata in the project area are in satisfactory soil condition and have the ability to resist accelerated erosion. Most strata in the ponderosa pine type currently have a closed stand structure and appear to have high canopy covers and densities. This has reduced understory forage productivity although there is generally sufficient vegetative ground cover to reduce accelerated erosion. Due to the closed stand structure, most soils and strata are at risk from the relatively high potential for crown fire (about 86 percent in FRCC 2 and 3). This also poses a high risk of moderate or high burn severity effects to the watersheds under normal or extreme fire behavior conditions. Fires resulting in moderate or high burn severity pose substantial risk to soil productivity, watershed function, and downstream water quality to connected stream courses on soils with moderate or high erosion hazard following storm events.

The desired condition is to protect long-term soil productivity by maintaining or improving soil condition and function (toward satisfactory). The vegetative ground cover would be adequate to protect against accelerated erosion resulting in maintained soil stability and vegetative productivity. Soil loss would be below tolerance, and no visible signs of excessive erosion are present. Surface soil hydrologic function would be in satisfactory condition with well aggregated, granular surface soil structure and tubular pores with sufficient porosity to effectively infiltrate water. Soil nutrient cycling would be in satisfactory condition. Vegetative ground cover, including surface litter and plant basal cover, and herbaceous understory would approach natural conditions identified in the "Terrestrial Ecosystem Survey Potential Plant Community Ecological Processes and Function" (USDA 1984).

Watersheds at the 6th Hydrologic Unit Code (HUC) Scale

The project lies within 82 6th code watersheds. The Watershed Condition Framework (WCF) protocol (USDA 2010a, 2010b) was used to classify watershed conditions at the 6th HUC level including 12 watershed indicators. Overall, ponderosa pine vegetation types are dominated by functional-at-risk 6th HUC watersheds (about 451,500 acres, or 46 percent of the analysis area); with several impaired watersheds (about 316,800 acres, or about 32 percent of the analysis area) and a few properly functioning watersheds (about 220,400 acres, or about 22 percent of the analysis area).

The desired condition is to have watershed function maintained or improved toward functioning properly. Watersheds would exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition. Fire regime condition class and tree density would be reduced and moving toward FRCC 1 (historical range). Unneeded roads would be decommissioned or restored to their natural condition. Soil and riparian condition and function would be improved and moving toward satisfactory and properly functioning.

Springs

Springs play an important role on the landscape for hydrological function of watersheds and they are very important for wildlife and plant diversity. They are natural water features that existed prior to Euro-American settlement and were probably functional due to lack of human disturbances (USDA 2009).

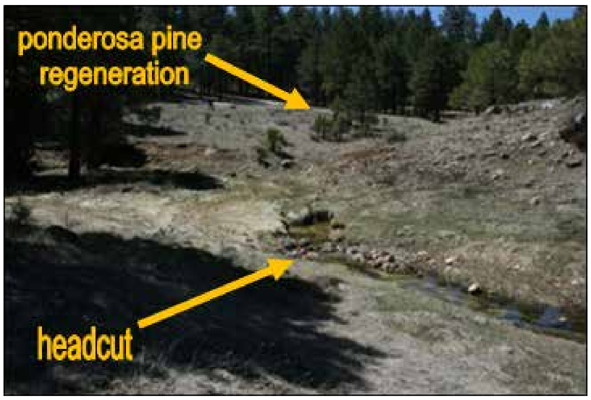

Figure 16. Degraded Babbitt Spring on the Coconino NF

Forty-nine developed springs on the Coconino NF are not functioning at or near potential and 25 springs on the Kaibab NF have reduced function (MacDonald 2013)[5]. However, springs are well represented throughout all the major watersheds on the forest. Spring function within the project area has been altered by human activities including flow regulation through installation of spring boxes and piping of discharge to offsite locations, recreational impacts, urbanization, and other construction activities, and grazing by domestic livestock and wildlife herbivores. As a result, many springs exhibit static or degraded conditions (MacDonald 2011). Excessive disturbance can also result in these features becoming nonfunctional (USDA 2009). Forty-seven developed springs on the Coconino NF are functioning below potential. On the Kaibab NF, 27 springs have reduced function (USDA 2008).

[5] Out of 78 total springs within the 4FRI project area, 4 springs were removed from treatment due to lack of information.

Figure 16 is a photo of Babbitt Spring, which has an impaired function. Babbitt Spring is located in the Lake Mary watershed on the Flagstaff district (Coconino NF) and is an example of spring conditions within the project area. The headcut in the spring outflow, the encroachment of ponderosa pine into the spring site, and the lack of riparian vegetation normally associated with a functioning riparian site are indicators of impaired fu nction.

Figure 17 displays Hoxworth Spring in a restored condition. This figure provides an example of successfully meeting restoration desired conditions. Vegetative composition and spring outflow has improved. Bank headcutting in the spring's outflow has been addressed and tree encroachment that affected spring function has been removed. The purpose of figure 18 is to display protective measures (fencing) that have been successfully used in the past to attain restoration desired conditions.

Figure 17. Restored Hoxworth Spring

The desired condition for springs is to have the necessary soil, water, and vegetation attributes to be healthy and functioning at or near potential. Waterflow patterns, recharge rates, and geochemistry would be similar to historic levels and persist over time. Water quality and quantity would maintain native aquatic and riparian habitat and water for wildlife and designated beneficial uses, consistent with water rights and site capability. Plant distribution and occurrence would be resilient to natural disturbances (USDA 1987). There is a need to improve the condition and function of 74 springs in order to sustain these features on the landscape. On some springs, this means maintaining and promoting existing vegetation. On others, there is a need to red uce tree encroachment, reduce the presence of noxious weeds, and limit the potential for future disturbance. On all springs, there is a need to return fire, a natural disturbance process, to the system.

Figure 18. Hoxworth Springs restoration

Ephemeral Streams

Ephemeral streams are important for hydrological function of watersheds and provide important seasonal habitat for a variety of wildlife, in particular, migratory birds and dispersing amphibians. Ephemeral streams are categorized as riparian or nonriparian. On the Coconino NF, approximately 32 miles of

Figure 19. Degraded ephemeral/riparian stream (Coconino NF)

ephemeral streams are heavily eroded with excessive bare ground, denuded vegetation, and head cuts. Of the total miles, approximately 6 miles are riparian streams and 26 miles are nonriparian streams. The Kaibab NF has approximately 7 miles (total) of degraded nonriparian streams. Figure 19 shows an active headcut and lateral bank cutting that resulted in accelerated erosion rates. This condition is common in the project area.

The desired condition is to restore the functionality of ephemeral streams (USDA 1987). On some of the total miles of stream, there is a need to maintain and promote existing vegetation. On others, there is a need to reduce tree encroachment, the presence of noxious weeds, and limit the potential for future disturbance. On all ephemeral streams, there is a need to return fire, a natural disturbance process, to the system.

Figure 20. Restored Hoxworth Spring drainage immediately post-treatment (photo on left) and 1 year post-treatment (photo on right)

The left-hand side of figure 20 shows the channel immediately after recontouring. The purpose of this figure is to display what restoration is likely to look like in the short term. The right-hand side of the figure displays the channel 1 year after treatment. This figure displays the desired condition for ephemeral stream restoration.

Roads and Unauthorized Routes

The Coconino and Kaibab NFs have identified the needed road system for public and administrative motorized use through the Travel Management Rule (TMR) process (see the transportation specialist report for details on forestwide transportation analyses). The TMR process identified a need to decommission approximately 770 miles of existing system and unauthorized roads on the Coconino NF. On the Kaibab NF, approximately 134 miles of unauthorized roads (often referred to as user-created routes) were recommended for decommissioning.

The desired condition is to restore decommissioned road prisms to their natural condition (USDA 1987, USDA 1988). Soils would be in satisfactory condition so that the soil can resist erosion, recycle nutrients, and absorb water. Understory species (e.g., grasses, forbs, and shrubs) diversity would be consistent with site potential and provide for infiltration of water and reduction of accelerated erosion. The understory would have a variety of heights of cool and warm season vegetation. Impacts to wildlife and habitat would be minimized.

About 2,820 miles of road would be needed to implement the project. Of this total, approximately 2,297 miles are existing, open roads. However, portions of these existing roads have resource concerns, which require maintenance or reconstruction prior to utilizing. In some parts of the project area, there are no existing roads that could provide access to treatments, or records and field review indicate the roads have been decommissioned in previous projects. For additional information, see the transportation inventory in the project record.

There is a need to have adequate access to the project area for implementation. Adequate access includes utilizing existing roads and temporarily creating roads that can be returned to their natural state (decommissioned) at the completion of project activities. Maintenance, reconstruction, and restoration actions would be designed to meet the site-specific condition as possible and practicable.

Decision Framework

The Coconino and Kaibab NFs supervisors are the Forest Service officials responsible for deciding whether or not to select the preferred alternative (alternative C), select one of the other action alternatives (alternative B or D), or select no action (alternative A). Their decision includes determining: (1) the location and treatment methods for all restoration activities; (2) design criteria, mitigation, and monitoring requirements; (3) the components that will be included in the adaptive management plan; (4) the components that will be included in the implementation checklist and plan; (5) the estimated products or timber volume to make available from the project; and (6) whether the forest plans will be amended as proposed.

Other Planning Efforts

See pages 7 to 8 for the discussion on the relationship between the revised forest plans and the revised MSO recovery plan (USDI 2012) to this analysis. Other restoration activities (actions on private, State, and other non-Forest Service lands) that influence/are complementary to this analysis are addressed in cumulative effects.

Relationship to the Forest Plans

The Coconino NF and Kaibab NF forest plans set forth in detail the direction for managing the land and resources of the forests. The desired conditions for the project are based on forest plan objectives, goals, standards, and guidelines. This analysis tiers to each forest's final EIS (USDA 1987) (USDA 1988), as encouraged by 40 CFR 1502.20. Best available science was used to develop desired conditions that are consistent with forest plan revision.

Management Direction

The project area includes 23 management areas (MA) as described in the Coconino National Forest plan (pages 46 to 206-113). Table 14 displays the MAs located within the project area, forest plan MA emphasis, and the relationship between MA total acreage to the project. The MA direction for the Flagstaff/Lake Mary Ecosystem Analysis Area (FLEA) MA is displayed throughout the 10 MAs that make up the FLEA.

On the Kaibab NF, the project area includes five geographic areas (GAs) and one land use zone (LUZ). Approximately 183,729 acres of GA 2 (Williams forest land) and 41,012 acres of GA 10, (Tusayan forest land) are proposed for treatment in the project area. About 8,353 acres of treatment are proposed within GA 1 (Western Williams Woodland), GA3 (North Williams

Woodland), and GA 8 (Tusayan Woodland). Treatments are proposed within about 1,049 acres of LUZ 21 (existing developed recreation sites). Table 14 displays the acreage associated with the MAs and GAs in the project area where the majority of restoration actions are proposed. Figure 21 displays the general location of the management areas (MAs) and geographic areas (GAs) in the project area.

For additional information, see chapter 4 of the forest plans ("Coconino National Forest Land and Resource Management Plan," pages 21 to 206-118; "Kaibab National Forest Land and Resource Management Plan," pages 16 to 114) where detailed descriptions of forestwide resource direction specific to management or geographic areas and land use zones is located.

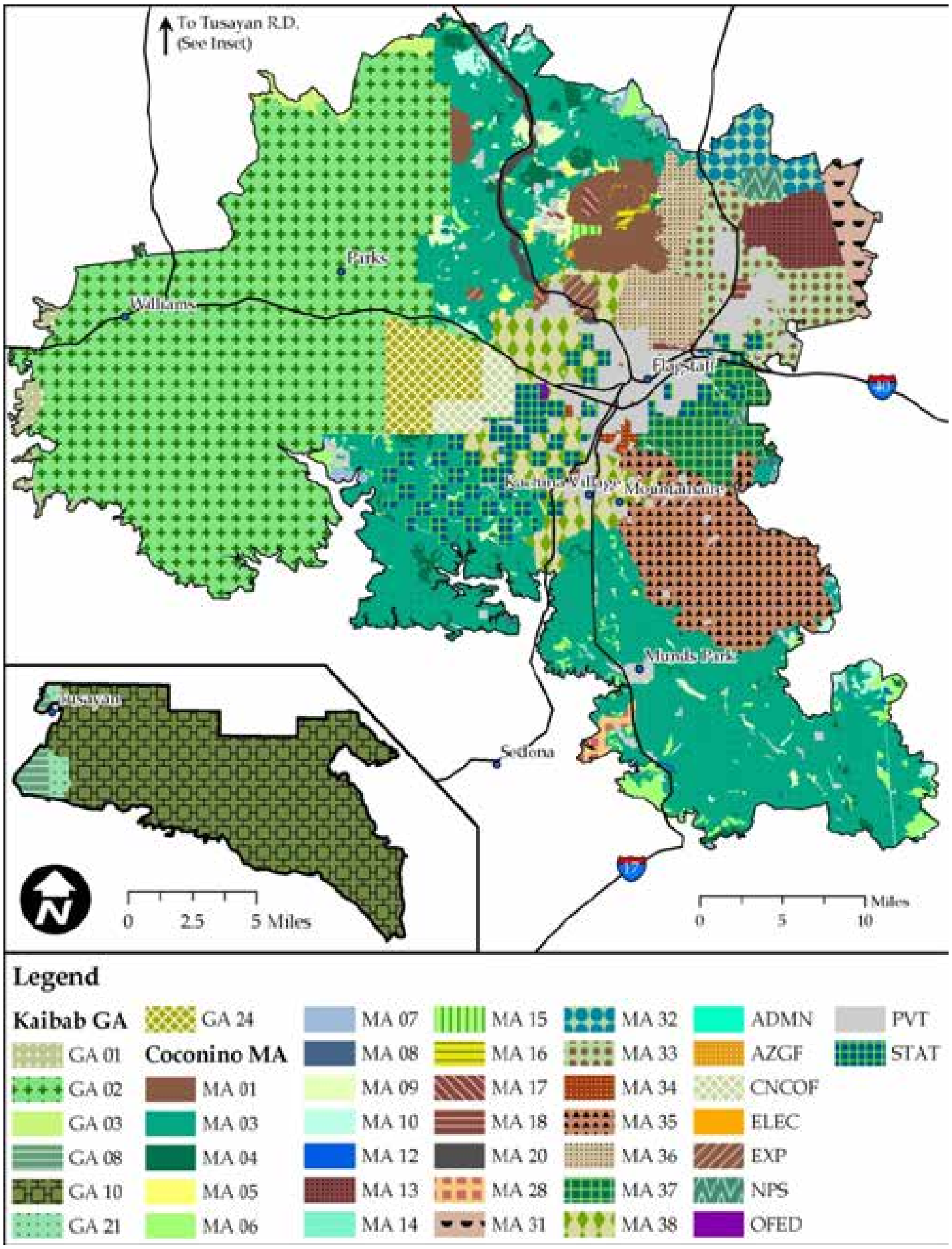

Figure 21. Forest plan management and geographic areas within the project area

Table 14. Forest plan management areas (MA), geographic areas (GA), and land use zones (LUZ) within the project area

Forest Plan MAs and GAs within the Project Area*	Description	Forest Plan Emphasis	Forestwide MA and GA Acres	MA and GA Acres within Project Area	Acres/Percent of Forestwide MA/GA Proposed for Treatment
Coconino National Forest					
MA 3	Ponderosa pine and mixed conifer on less than 40% slope	Sustained yield of timber and firewood, wildlife habitat, grazing, high quality water, dispersed recreation	511,015	236,245	190,763/37
MA 35	Lake Mary Watershed	Maintenance and/or improvement of soil condition and watershed function, reduced fire risk in urban/rural influence zone	62,536	59,301	37,801/60
MA 38	West	Reduced fire risk in urban/rural influence zone, recreation, scenic quality	36,298	36,134	19,538/54
MA 33	Doney	Reduced fire risk in urban/rural influence zone, recreation, grasslands, scenic quality	40,530	25,779	14,023/35
MA 36	Schultz	Reduce wildfire risk, maintain watershed health, and water quality	21,289	21,130	7,069/33
MA 37	Walnut Canyon	Reduce fire risk in urban/rural interface zone, progress toward desired forest structure including MSO and goshawk habitats	20,566	18,030	6,420/31
MA 13	Cinder Hills	OHV recreation opportunities and amenities, scenic integrity, geologic features	13,711	13,732	13,670/99
MA 6	Unproductive timber lands	Wildlife habitat, watershed condition, grazing	67,146	12,115	11,628/17
MA 4	Ponderosa pine and MC above 40%	Wildlife habitat, watershed condition, and dispersed recreation	46,382	11,793	8,107/18
MA 32	Deadman Wash	Grasslands, unroaded landscape, grazing, hunting	58,133	11,659	11,380/20

Forest Plan MAs and GAs within the Project Area*	Description	Forest Plan Emphasis	Forestwide MA and GA Acres	MA and GA Acres within Project Area	Acres/Percent of Forestwide MA/GA Proposed for Treatment
MA 31	Craters	Restore natural grasslands, reestablish or maintain fire in pinyon-juniper woodland	29,940	8,969	8,969/15
MA 10	Transition grassland/sparse PJ above Mogollon Rim	Range management, watershed condition, and wildlife habitat	160,494	8,544	8,012/5
MA 9	Mountain grasslands	Livestock grazing, visual quality, wildlife habitat	9,049	7,102	5,385/60
MA 20	Highway 180 corridor	Scenic attraction, access to year-round recreation and Grand Canyon NP	7,608	6,213	4,237/56
MA 7	PJ woodlands < 40%	Firewood production, watershed condition, wildlife habitat, grazing	19,077	3,206	3,203/17
MA 5	Aspen	Wildlife habitat, visual quality, sustain yield of firewood production, watershed condition, dispersed recreation	3,450	2,761	695/20
MA 28	Schnebly Rim	Seasonal gateway, conserve winter range for deer, elk, turkey	5,090	2,455	2,455/48
MA 34	Flagstaff	Reduce risk of catastrophic wildfire, recreation, scenic quality	1,781	1,675	1,460/82
MA 18	Elden Environmental Study Area	Visual resource management, watershed condition, manage for low fire potential with fire reestablished	1,577	1,611	337/21
MA 12	Riparian and open water	Wildlife habitat, visual quality, fish habitat, watershed condition on the wetlands, riparian forest, and riparian scrub, dispersed recreation on the open water portions	20,490	653	609/3
MA 8	PJ woodlands > 40 %	Firewood production, watershed condition, wildlife habitat, and livestock grazing	273,815	451	248/<1

Forest Plan MAs and GAs within the Project Area*	Description	Forest Plan Emphasis	Forestwide MA and GA Acres	MA and GA Acres within Project Area	Acres/Percent of Forestwide MA/GA Proposed for Treatment
MA 15	Developed recreation sites	Developed recreation	874	805	48/6
MA 14	Oak Creek Canyon	Scenery, recreation, wildlife habitat, healthy streams, clean air and water, manage fire hazards and risk	5,388	7	7/<1
Kaibab National Forest					
GA 2	Williams Forest land	Suitable timberland, recreation, grazing, wildlife habitat	308,394	299,842	181,371/59
GA 10	Tusayan Forest land	Wildlife habitat, recreation, grazing	86,250	43,559	41,012/48
GA 1	Western Williams Woodland	Wildlife habitat, sandstone products, scenic routes and features, grazing, wild burro territory	169,041	4,807	3,360/2
GA 3	Northern Williams Woodland	Winter wildlife habitat, scenic routes and features, grazing	65,533	3,485	3,475/5
GA 8	Tusayan Woodland	Wildlife habitat, scenic routes and features, grasslands, grazing	195,118	1,518	1,518/1
LUZ 21	Existing developed recreation sites	Existing public and private sector developed recreation sites and other smaller sites (trailheads, interpretive sites, etc.)	1,556	1,049	1,049/67

*Acres and percentages are approximate as many mapping inconsistencies were found when we compared the management area boundary maps to vegetation stand data. Forest plan MA mapping was conducted at a very coarse scale whereas the numbers associated with our vegetation stand data is much more precise. The FLEA MA on the Coconino NF is comprised of MA 3, 4, 5, 8, and 9 which are included in the table.

Public Involvement

Collaboration

Collaboration has been integral to moving forward with a landscape restoration proposal. In 2010, stakeholders began refining their vision for ponderosa pine forest restoration across 2.4 million acres on four national forests in Arizona including the Apache-Sitgreaves, Coconino, Kaibab, and Tonto. The 4FRI stakeholders developed a comprehensive restoration strategy for the Coconino and Kaibab NFs (4FRI Stakeholders 2010). The landscape strategy documented existing conditions, identified potential treatment areas, and desired post-treatment conditions. The Forest Service used the stakeholder's landscape strategy to inform the purpose and need and proposed action.

Scoping

The project was posted in the Coconino and Kaibab NF's schedule of proposed actions (SOPA) in January of 2011 and the notice of intent (NOI) to prepare an EIS was published in the Federal Register on January 25, 2011 (FR Doc. 2011–1444).

A draft proposed action was sent to a mailing list (hard copy and electronic mail) of 1,331 individuals, local government, State government, Federal and State agencies, and organizations. Fifty-four responses were received through May 5, 2011. A scoping report that included a summary of the scoping process was posted on the 4FRI Web site on June 29, 2011 (http://www.fs.usda.gov/4fri).

In addition to a pre-scoping public meeting/workshop held on January 20, 2011, meetings/workshops were held on the Coconino NF on February 2, 2011, February 16, 2011, and February 24, 2011. A meeting/workshop was held on Kaibab NF on February 9, 2011. The purpose of these meetings was to receive comments that would be used to develop a revised proposed action. The sixth public meeting was held at the Coconino NF Supervisor's Office on April 27, 2011, for the purposes of providing a project update. A public meeting was held on June 7, 2011, for the purposes of receiving comments on edits made to the proposed action. On average, meeting/workshop attendance ranged from 10 to 20 participants.

A revised proposed action was sent to a mailing list of 213 parties (169 electronic mail and 44 hard copy recipients) and a second 14-day public comment period began with publication of a second revised NOI in the Federal Register on August 19, 2011 (FR. Doc. 2011–20496). Thirty-four comments were received during this informal 2-week comment period. Eight comments received prior to the informal comment period (May 12, 2011 to July 26, 2011) and three comments received after the close of the comment period (September 4 to September 8, 2011) were accepted as part of the public involvement process. In sum, 45 comments were received from May 12, 2011, to September 8, 2011.

Prior to the onset of the August 19, 2011, comment period, an open house was held on August 17, 2011, at the Coconino NF Supervisor's Office. Six people attended the open house. During the comment period, an open house was held on August 25, 2011, at the Williams Ranger District (Kaibab NF). Eleven Forest Service personnel from the Kaibab NF attended the open house. As part of coordination with local governments and residents, project updates were provided to the Coconino City Council and city of Flagstaff on September 12, 2011, and again on December 5, 2011. The Tusayan and Camp Verde City Council received a project update on October 5, 2011.

The Sedona and Williams City Council was updated on October 25, 2011.Updates to local residents and communities were provided at the Mountainaire Community Picnic (at the invitation of the Coconino County Supervisor) on September 17, 2011, and via an educational booth at the Flagstaff Festival of Science in September of 2011 and 2012.

In the fall of 2011, meetings were held with commenters to clarify comments received on the revised proposed action. This included hosting meetings to discuss comments on large trees on October 14, 2011, and on canopy cover (in relation to forest plan goshawk guidelines) on December 15, 2011 (Coconino NF Supervisor's Office).

In 2012, monthly public meetings were hosted from March through July to discuss the status of the environmental analysis. Draft (working) documents shared at the public meetings and made available on the 4FRI Web site (http://www.fs.fed.usda.gov/main/4fri/planning) included: issues, alternatives, draft forest plan amendments, cumulative effects, scoping report (August 2011 scoping period), and version 5 of the modified large tree retention implementation strategy (alternative C).

Only a sampling of the public involvement effort is included in this summary. See the project record for complete documentation. The project has been continuously posted on the Coconino and Kaibab NFs' SOPA since January of 2011 and public involvement and analysis related documents have been posted on the 4FRI Web site, http://www.fs.usda.gov/4fri since January 2011.

Cooperating Agencies

On March 11, 2011, the Arizona Department of Game and Fish (AGFD) became a cooperating agency. The AGFD provided a habitat specialist to assist with the wildlife management indicator species (MIS) effects analysis.

Tribal Consultation

The following tribes and tribal chapters who have historic ties and an interest in the Coconino and Kaibab National Forests were consulted with and include: Kaibab Band of Paiute Indians, Navajo Nation including Coppermine, Coalmine, Naness, Lechee, Leupp, Bodaway, Cameron, Tuba City, Dilkon and Tolani Lake Chapters, Kaibab Band of Paiute Indians, San Juan Southern Paiute, White Mountain Apache, Yavapai-Apache Nation, San Carlos Apache, Hualapai, Yavapai-Prescott Indian Tribe, Havasupai, Tonto Apache, Pueblo of Zuni, Pueblo of Acoma, Hopi, and Fort McDowell Yavapai Nation.

Consultation began September 10, 2009, with the Kaibab NF supervisor sending an invitation to seven federally recognized tribes to discuss 4FRI and other forest projects. On January 27, 2011, the forests sent a letter to tribes and tribal chapters providing information and seeking involvement and comments. Two written scoping responses were received. The White Mountain Apache responded on February 17, 2011, and indicated no concern with the project. A response from the Havasupai Tribe on March 7, 2011, asked for additional information on what the expected outcome of the proposals would be.

On August 22, 2011, a second scoping letter was sent to the tribes. Tribes responded and provided additional input and voiced concerns during consultation meetings. Concerns include the following:

- Traditional cultural properties are at risk to catastrophic fire;
- Springs and plant collection areas are at risk to catastrophic fire;
- Overstocked stands are reducing the sunlight available for cultural and medicinal plants;
- Springs that are important to tribal ceremonies are drying up;
- A lack of low-intensity fire is reducing regeneration of plant collection areas;
- Smoke may affect some tribal communities;
- Tribes need access to sites for ceremonies and traditional gathering, and;
- Tribes are concerned with the preservation of cultural resources.

Tribes that have not participated in tribal consultation will continue to receive information via email and hand delivered mail. Information will be shared unless a tribe asks specifically to not be informed. See the "Tribal Relations" section in chapter 3 and the tribal relations specialist report for the complete consultation documentation.

Issues

Issues serve to highlight effects or unintended consequences that may occur from the proposed action, giving opportunities during the analysis to reduce adverse effects and compare tradeoffs for the decision maker and public to understand. In order to identify issues, the interdisciplinary team (IDT) reviewed and considered all scoping comments during both phases of the public involvement period. How scoping comments were addressed and were used to inform the analysis can be viewed in the final scoping report that is posted on the 4FRI Web site or in the project record. Following are the key issues identified by the public and used to focus the analysis or drive alternative development.

Issue 1: Prescribed Fire Emissions

Emissions resulting from prescribed fire activities would occur continuously over a 10-year period. Project emissions would degrade air quality and the health of northern Arizona residents, particularly residents of the Verde Valley and Snowflake, Arizona. This project, when combined with prescribed fires that other forests conduct, would negatively impact northern Arizona residents. Residents would experience constant smoke (an emission) over a long period of time. Reduced visibility and air quality from smoke would negatively affect the quality of life for residents and would reduce tourism in the area. The reduction of tourism would result in long-term impacts to the local and regional economy of northern Arizona. The volume of smoke and the emissions that are part of smoke could affect public health. An alternative that: (1) eliminates all use of prescribed fire, (2) eliminates most prescribed fire use and relies on other methods to dispose of biomass, and (3) improves coordination amongst all forests that use prescribed fire in the vicinity of the Verde Valley and Snowflake is needed. There needs to be smoke-free periods for residents downwind of the project.

Response

An alternative that would eliminate all prescribed fire was considered but eliminated from detailed study as it did not adequately meet the purpose and need for restoring the fire adapted southwestern ponderosa pine ecosystem. Alternatives B and C propose using prescribed fire across the entire project area and alternative C adds acres on which prescribed fires would be used to restore additional acres of grasslands. Alternative D was developed to respond to the emissions/smoke issue by decreasing the acres proposed for prescribed fire. All action alternatives include design criteria aimed at reducing impacts to air quality (as practicable) and increasing coordination efforts amongst neighboring forests. The fire ecology, air quality, recreation, and social-economics environmental consequences disclose the potential impacts to air quality, quality of life, the local and regional economy, and public health and safety. The indicators used to evaluate this issue are:

- Quantitative emission modeling and qualitative interpretation to evaluate the potential for emissions within communities that are within, or in close proximity to, the project;
- Modeling of principal pollutants including carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter less than 10 microns in size (PM_{10}), particulate matter less than 2.5 microns in size ($PM_{2.5}$), ozone (O_2), and sulfur dioxide (SO_2) pollutants that pose potential health hazards to evaluate compliance with the Clean Air Act as regulated by the Arizona Department of Environmental Quality (ADEQ); and
- Social and economic evaluation of impacts to quality of life and tourism.

Issue 2: Conservation of Large Trees

The large tree retention strategy (LTRS), which was developed by the 4FRI stakeholders, was not included in the proposed action. Large post-settlement trees, as defined by a socio-political process, are those greater than 16-inch d.b.h. The LTRS was designed to increase landscape heterogeneity and conserve biodiversity. The LTRS represents social agreement between parties that greatly enhances the chance for landscape restoration to succeed and reduces the risk of conflict. If the LTRS is not incorporated, the current social support for landscape-scale restoration may be withdrawn. In addition, it may result in the removal of key ecosystem components that include nesting and roosting habitat and large woody debris that is important for wildlife.

Response

The vegetation analysis will evaluate how proposed treatments affect vegetation structural stages (VSS), including those trees that are 16-inch d.b.h. or larger. This analysis will be used to inform the wildlife effects analysis. Alternatives B (proposed action alternative) and D do not incorporate the LTRS. However, alternative C responds to this issue by incorporating the key components of the LTRS and focusing on ecological desired conditions. It identifies ecological conditions where large, post-settlement trees may (or should) be removed in order to move toward or meet desired conditions. The intent of the LTRS has been incorporated into the alternative’s design criteria, the monitoring and adaptive management plan, and the project implementation plan.

The indicators used to evaluate this issue are:

- Quantitative pre-treatment and post-treatment three-level analysis for MSO, goshawk, old growth, and VSS for goshawk habitat at the landscape scale (ponderosa pine vegetation type) to gauge movement toward restoration desired conditions, and
- Qualitative analysis of pre-treatment and post-treatment nonmarket social values that include large trees, public safety, and other biodiversity objectives that may conflict with the protection of large trees.

Issue 3: Post-Treatment Canopy Cover and Landscape Openness

Measuring canopy cover in goshawk habitat at the group level will not meet forest plan stand-scale canopy requirements. A reduction in canopy and large tree densities have never been analyzed under NEPA and NFMA and could have deleterious effects to goshawk, its prey species, and those wildlife species that are dependent on that cover. Because natural openings would no longer be included within the VSS classification, it would result in significantly more lands being in an open condition or outside of the VSS 4 to 6 classifications. This could substantially increase the logging of mature and old trees, and negatively affect wildlife, including goshawk and its prey species.

Response

All action alternatives (B, C, and D) are designed to meet canopy cover in VSS 4 to VSS 6 in compliance with the forest plans. The vegetation analysis addresses the interrelationship between canopy cover and old and large trees.

To address post-treatment openness and canopy cover where the desired condition is to move toward an open ponderosa pine (savanna/grassland) reference condition, a nonsignificant forest plan amendment was developed for alternatives B, C, and D. The amendment describes how canopy cover will be measured and met at the group level, includes language that defines and describes interspaces, and describes the relationship between interspaces, openings, and VSS classes. It would also allow select acres to be managed for less than 40 percent canopy cover in VSS 4 to VSS 6 and less than 3 to 5 reserve trees per acre.

The analysis discloses tree group stocking guides that would be used to meet tree group canopy cover requirements and evaluates the following within goshawk habitat: pre- and post-treatment distribution of habitat structure, overall habitat structure (VSS class), forest density metrics, and openness.

Issue 4: Increased Restoration and Research

Increased Restoration: Additional acres of grassland restoration treatments in the vicinity of Government Prairie and the proposed Garland Prairie Research Natural Area are needed on the Kaibab NF. The historic grasslands are being encroached upon by pine. Additional acres of prescribed fire and restoration treatments should occur within MSO protected habitat to further improve the quality of MSO roosting and nesting habitat and align with the MSO recovery plan (USDI 2012).

Research: Research that evaluates the effect of residual tree groups and treeless opening size on small mammals and bird species should be included in projects of this scale. Research that evaluates the impact of landscape-scale restoration actions to water yield should be incorporated. Outcomes from wildlife and water yield research can inform future restoration projects.

Response

Alternative C responds to recommendations to include mechanical and/or prescribed fire treatments in the vicinity of Government Prairie and within the proposed Garland Prairie Research Natural Area (RNA) on the Kaibab NF to move this area closer to its historic reference condition. The alternative responds to recommendations from FWS to increase prescribed burning treatments within protected habitat by increasing the acres of prescribed burning to 72 protected activity centers, including 56 core areas. In target threshold habitat, the desired basal area in protected activity centers is adjusted to be in alignment with the MSO recovery plan. Alternative C adjusts vegetation (decreases acres) and prescribed burning (increases acres) treatments in order to incorporate two research opportunities. One study would evaluate the effect of residual tree groups and treeless opening size on small mammals and bird species. The second study would evaluate water yield from landscape-scale restoration actions.

The indicators used to evaluate this issue are:

- Acres of grassland vegetation moving toward desired conditions
- Acres of improved MSO nesting and roosting habitat
- Qualitative assessment of alignment with MSO recovery plan

Proposed Action Development

During the initial phase of scoping (January 2011 to June 2011), meetings and workshops were held for the purpose of refining the draft proposed action. We recorded many comments requesting additional detail on what vegetation and prescribed fire treatments would look like once implemented. Many commenters provided input and recommendations on identifying and prioritizing resources and infrastructure at risk from high severity fire. Treatment in these locations is reflected in the proposed action (and subsequent alternatives).

Another topic that emerged was the conservation of old trees. In response to recommendations, key concepts from the stakeholder developed old tree protection strategy (OTPS) were incorporated into the purpose and need (4FRI Stakeholders 2011). Treatment design criteria and mitigation (which are consistent with the OTPS) were developed and the OTPS was made integral to the revised proposed action as an attachment (appendix E, August 2011 proposed action document). An old tree implementation plan was developed and made part of the final proposed action alternative (and all subsequent alternatives).

As the analysis progressed, the need to better describe treatments within MSO protected activity centers (PACs) was raised by the FWS. In response, the language in the proposed action was revised to clarify that mechanical treatment was proposed in 18 select PACs and the use of prescribed fire was proposed in 72 PACs, excluding core areas.

As the proposed action was refined, the concept of adaptive management was incorporated into the proposal to provide flexibility to account for inaccurate initial assumptions, to adapt to changes in environmental conditions, and/or to respond to subsequent monitoring information that indicates that desired conditions are not being met (USDA 2011, 2012). With this objective in mind, vegetation treatments were designed to have a range of treatment types and intensities. Having a range of treatment options facilitates implementing a treatment that best responds to the site-specific resource condition and most effectively allows movement toward desired conditions. Related documents that are part of the final proposed action alternative (and subsequent alternatives) include the implementation plan (appendix D) and the monitoring and adaptive management plan (appendix E) developed in collaboration with the 4FRI stakeholders). The purpose of the implementation plan is to ensure that actions taken under adaptive management are consistent with the predicted effects and decision.

Changes to the Proposed Action After the August 17, 2011, Scoping Period

After public scoping comments were reviewed and more intensive analysis was performed by resource specialists, the Coconino and Kaibab NF supervisors approved modifications to the proposed action (alternative B), as allowed by 36 CFR 220.7(b)(2)(iii). A summary of key changes includes:

- Incorporating the old tree protection strategy into the final proposed action, implementation plan, and monitoring/adaptive management plan
- Correcting acreages (and terms as needed) for vegetation types, goshawk and MSO habitats, old growth allocations, and road miles
- Identifying forest plan amendments, including adding an amendment for cultural resources on the Coconino NF and adding language to the draft MSO amendment to address population and habitat monitoring in MSO habitat
- Clarifying and finalizing road treatment type, amount, and definitions, including those proposed in MSO and goshawk habitat

A detailed list of changes made to the proposed action is located in the project record.

Final Proposed Action

The Coconino and Kaibab NFs propose to conduct approximately 587,923 acres of restoration activities over approximately 10 years or until objectives are met. Up to 45,000 acres of vegetation would be mechanically treated annually. Up to 40,000 acres of prescribed fire would be implemented annually across the forests. Two prescribed fires would be conducted on all acres proposed for treatment over the 10-year period. Restoration activities would:

- Mechanically cut trees and apply prescribed fire on approximately 388,489 acres. This includes: (1) mechanically treating up to 16-inch d.b.h. within 18 MSO protected activity centers, (2) cutting 99 acres of trees by hand on slopes greater than 40 percent, and (3) using low severity prescribed fire within 72 MSO PACs (excluding core areas).
- Utilize prescribed fire only on approximately 199,435 acres.
- Construct 517 miles of temporary roads for haul access and decommission when treatments are complete (no new permanent roads would be constructed).
- Reconstruct up to 40 miles of existing, open roads for resource and safety concerns (no new permanent roads would be constructed). Of these miles, approximately 30 miles

would be improved to allow for haul (primarily widening corners to improve turn radiuses) and about 10 miles of road would be relocated out of stream bottoms. Relocated roads would include rehabilitation of the moved road segment.

- Decommission a total of 904 miles of roads that includes 770 miles of existing system and unauthorized roads on the Coconino NF and 134 miles of unauthorized roads on the Kaibab NF.
- Restore 74 springs and construct up to 4 miles of protective fencing.
- Restore 39 miles of ephemeral channels.
- Construct up to 82 miles of protective (aspen) fencing.
- Allocate as old growth 40 percent of ponderosa pine and 77 percent of pinyon-juniper woodland on the Coconino NF and 35 percent of ponderosa pine and 58 percent of pinyon-juniper on the Kaibab NF.

Three nonsignificant forest plan amendments (see appendix B) would be required on the Coconino NF to implement the proposed action:

> **Amendment 1** would add language to allow mechanical treatments up to 16-inch d.b.h. to improve habitat structure (nesting and roosting habitat) in 18 MSO PACs. The amendment would remove language that limits PAC treatments in the recovery unit to 10 percent increments and language that requires the selection of an equal number of untreated PACs as controls. The amendment would remove language referencing monitoring (pre- and post-treatment, population, and habitat monitoring). Replacement language would defer final project design and monitoring to the FWS's biological opinion specific to MSO for the project.
>
> The amendment, which is specific to restricted habitat in pine-oak, would allow for designating less than 10 percent of restricted habitat on the Coconino NF as target or threshold (i.e., future nesting and roosting habitat) based on the quality of the habitat. Definitions of target and threshold habitat would be added.
>
> **Amendment 2** would add the desired percentage of interspace within uneven-aged stands to facilitate restoration in goshawk habitat (excluding nest areas), add the interspace distance between tree groups, add language clarifying where canopy cover is and is not measured, allow 29,017 acres to be managed for an open reference condition, and add a definition to the forest plan glossary for the terms interspaces, open reference condition, and stands.
>
> **Amendment 3** would remove the cultural resource standard that requires achieving a "no effect" determination and would add the words "or no adverse effect" to the remaining standard. In effect, management would strive to achieve a "no effect" or "no adverse effect" determination.

Two nonsignificant forest plan amendments (see appendix B) would be required on the Kaibab NF to implement the proposed action:

> **Amendment 1** would add the desired percentage of interspace within uneven-aged stands to facilitate restoration in goshawk habitat (excluding nest areas), add

the interspace distance between tree groups, add language clarifying where canopy cover is and is not measured, allow 27,637 acres to be managed for an open reference condition, and add a definition to the forest plan glossary for the terms interspaces, open reference condition, and stands.

Amendment 2 would allow for designating less than 10 percent of restricted habitat in pine-oak as target or threshold (i.e., future nesting and roosting habitat) based on the quality of the habitat. The amendment would remove language that limits PAC treatments in the recovery unit to 10 percent increments and requires the selection of an equal number of untreated PACs as controls. Replacement language would defer to the FWS biological opinion for the project. The amendment would also remove language that references monitoring (pre- and post-treatment, population, and habitat monitoring) and replace it with language that defers MSO monitoring to the FWS biological opinion for the project.

Figure 22 through figure 24 provide a coarse-scale overview of restoration treatment locations. Please refer to the description of alternative B (proposed action alternative) in chapter 2 for details that include tables and maps that display proposed treatments.

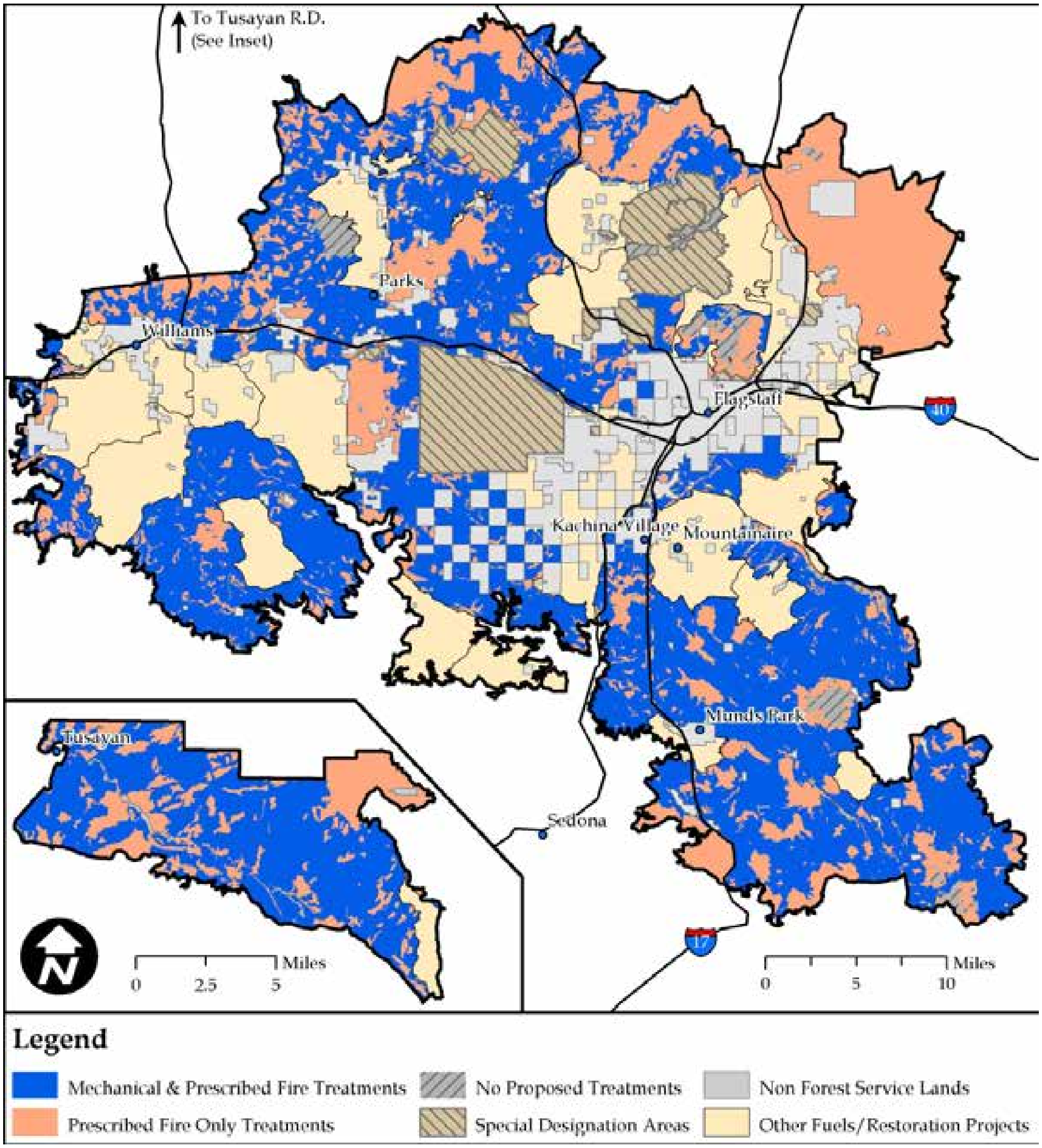

Figure 22. Final proposed action general locations of mechanical and prescribed fire treatments

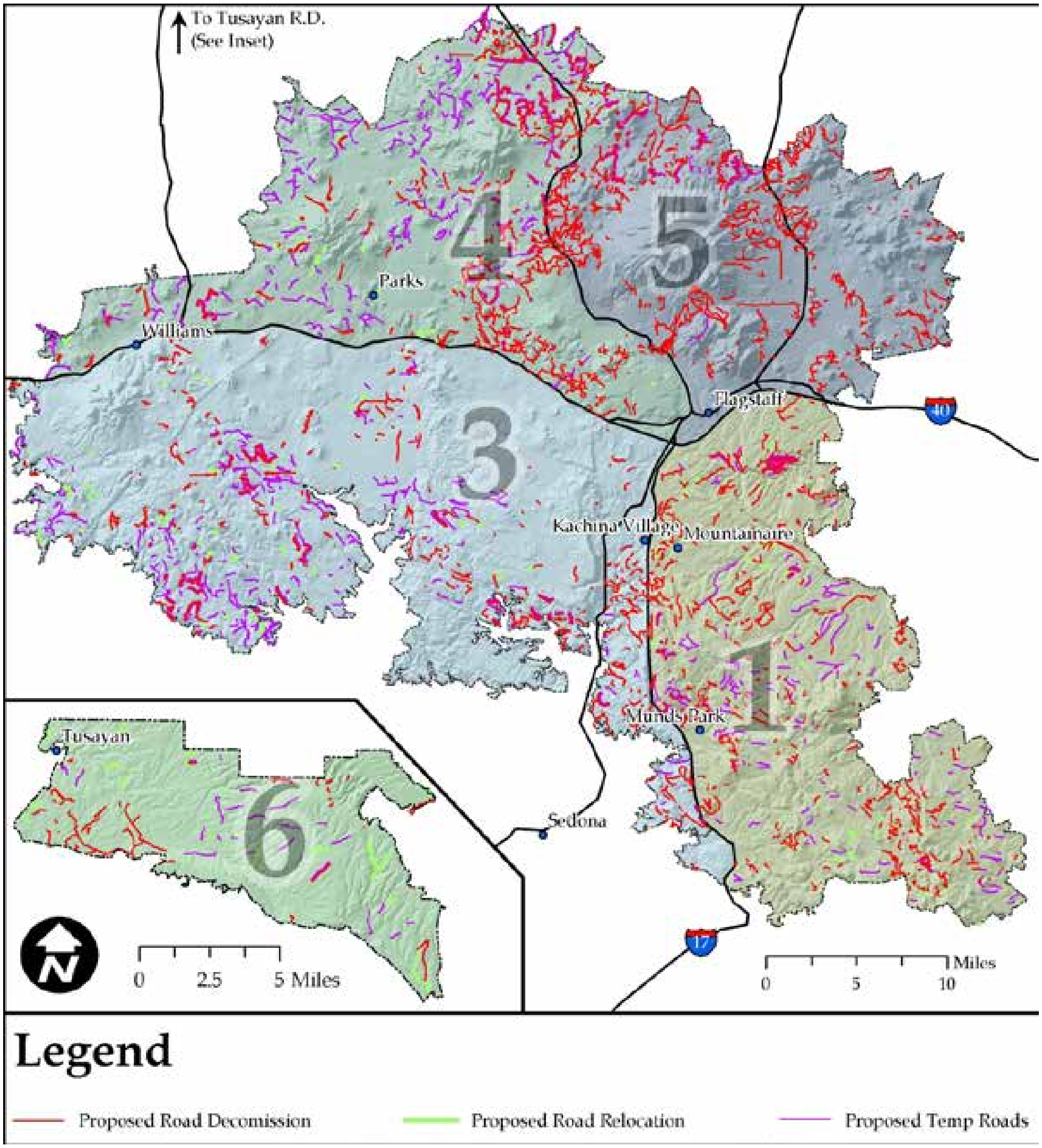

Figure 23. Final proposed action general locations of road activities by RU

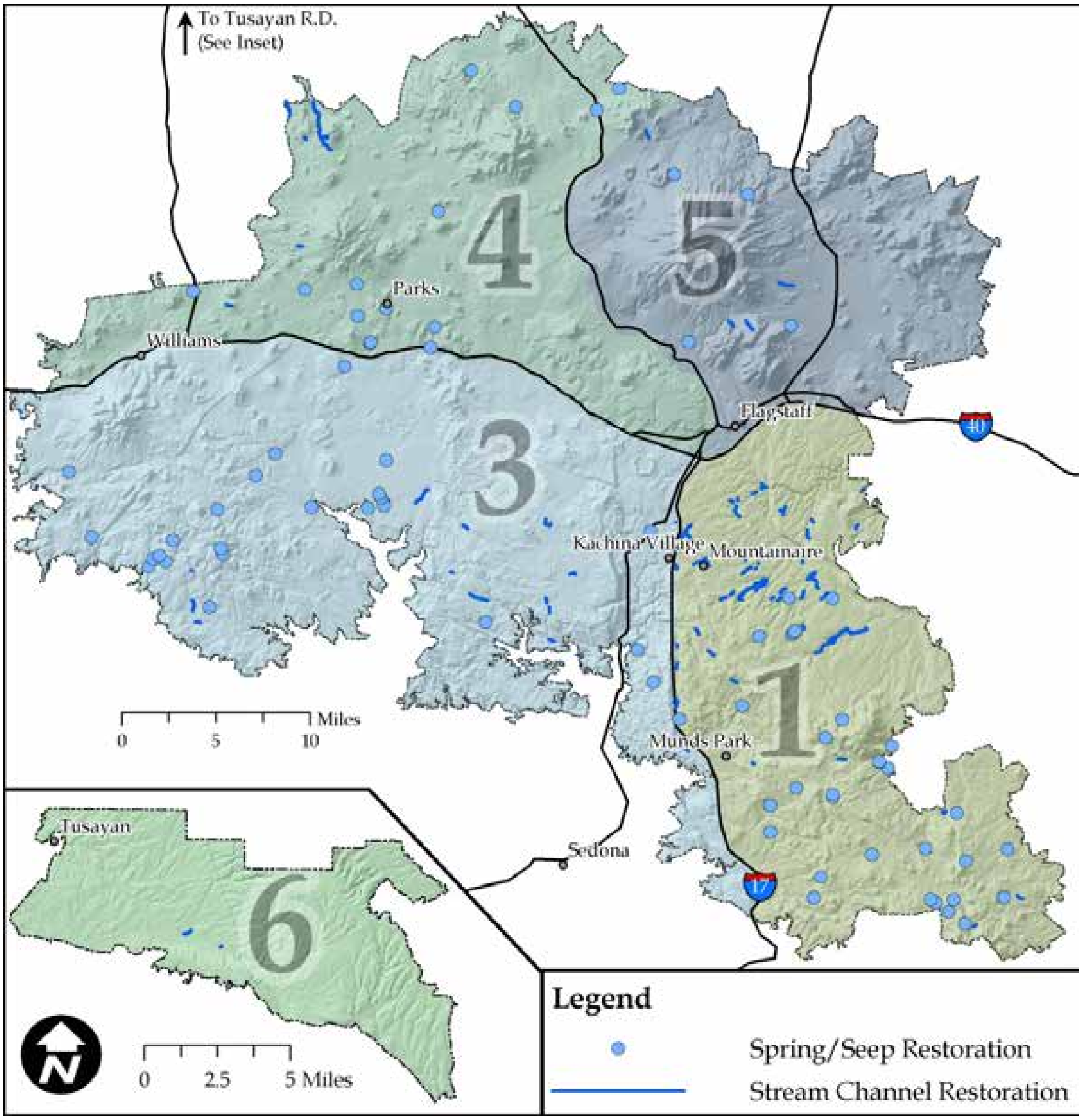

Figure 24. Final proposed action general location of spring and ephemeral channel restoration actions by RU

Chapter 2 – Alternatives

This chapter describes and compares the alternatives considered for the Coconino and Kaibab NFs' restoration project and presents the alternatives in comparative form, defining the differences between each alternative, and providing a clear basis for choice by the decision maker. Some of the information used to compare the alternatives is based upon the design of the alternative (appendix C) and some of the information is based upon the environmental, social, and economic effects of implementing each alternative (chapter 3).

Alternative Development Process

As a result of extensive collaboration over an 8-month timeframe and additional analysis, the proposed action was modified as allowed by 36 CFR 220.7(b)(2)(iii), which states that "the description of the proposal and alternative(s) may include a brief description of modifications and incremental design criteria developed through the analysis process to develop the range of alternatives considered."

Minor modifications included incorporating the stakeholder developed old tree protection strategy (OTPS) (with some modifications) into alternative B, correcting vegetation, habitat, old growth, and road acreages or miles, finalizing forest plan amendments, and developing the adaptive management and monitoring, and implementation plan. See the "Proposed Action Development" section in chapter 1 for additional information.

Those concerns that could not be addressed through minor modifications to the proposal were considered key issues and drove the development of two additional alternatives (see the "Issues" section in chapter 1). The minor modifications incorporated into the final proposed action (alternative B) were carried forward into the other alternatives.

Alternative C responds to **Issue 2**—conservation of large trees—by incorporating key components from the original 4FRI stakeholder created large tree retention strategy (4FRI stakeholders 2011) into the alternative's implementation plan. The alternative also responds to **Issue 4**—increased restoration and research. The alternative adds acres of grassland restoration treatment on the Kaibab NF. It includes recommendations from the U.S. Fish and Wildlife Service (FWS) by increasing prescribed burning treatments within protected Mexican spotted owl (MSO) habitat (to improve the quality of owl roosting and nesting habitat), and aligning treatments in threshold habitat with the "Mexican Spotted Owl Recovery Plan, First Revision" (USDI 2012). The alternative also adjusts treatments (decreases acres of mechanical treatment and increases the acres of prescribed fire) in order to incorporate two research opportunities including a small mammal and bird study and a water yield study.

Alternative D was developed to respond to **Issue 1**—prescribed fire emissions—by decreasing the acres on which prescribed fire would be utilized. Other attributes of alternative D, with the exception of the use of prescribed fire, are similar to alternative B.

All action alternatives (B–D) address **Issue 2**—post-treatment canopy cover and landscape openness—through quantitative and qualitative analysis and with a forest plan amendment for both forests. All action alternatives (B–D) propose additional activities including restoring springs and ephemeral channels, constructing protective fencing in select aspen stands, constructing (and decommissioning) temporary roads, reconstructing and improving roads, relocating a minimal number of road miles, and decommissioning existing roads and unauthorized routes. All action alternatives include design features, best management practices (BMPs), and mitigation measures (appendix C), an implementation plan (appendix D), and a monitoring and adaptive management plan (appendix E). The implementation plan includes direction for managing old trees. A modified version of the original stakeholder developed large tree retention strategy is only applicable to the implementation plan in alternative C.

Forest Plan Consistency

Forestwide and management/geographic area-specific standards and guidelines have been incorporated into the design of alternatives B, C, and D as displayed in appendix C. Other applicable forest plan requirements that have been incorporated by resource are in the resource specialist reports. With the proposed nonsignificant forest plan amendments (see appendix B), alternatives B, C, and D are consistent with the Coconino and Kaibab NFs forest plan direction. As discussed in chapter 1 (pages 7–8), the Coconino and Kaibab forest plans are currently under revision. Depending on the timing of the release of final documents, the final 4FRI analysis will be consistent with the plans in effect at that time.

Alternatives Considered but Eliminated from Detailed Study

The range of alternatives considered by the responsible officials includes alternatives to the proposed action that are analyzed in the document, as well as other alternatives considered but eliminated from detailed study. Public comments received in response to the proposed action suggested alternative methods for achieving the purpose and need, including an alternative that would: (1) utilize mechanical treatments limited to 8-inch d.b.h., (2) utilize prescribed fire as the sole treatment method, (3) eliminate the use of prescribed fire, (4) utilize the original large tree retention strategy, and (5) limit mechanical treatments to 16-inch d.b.h.

Limit Mechanical Treatments to 8-inch d.b.h.

This alternative was based on the assertion that crown fire can be effectively addressed with mechanical treatments that do not exceed 8-inch d.b.h. Small diameter mechanical tree cutting would be used to establish tree groups, nonforested openings (interspaces), and move toward a balance of tree age and size classes. Prescribed fire would be used to reduce litter and other surface fuels, stimulate herbaceous understory vegetation, prepare sites for natural ponderosa pine regeneration, and maintain interspaces.

This alternative was not analyzed in detail. After an initial analysis, it was determined that it would not meet various elements of the purpose and need, as described below. The purpose and need statement is displayed below in **bold** text.

The purpose of the project is to reestablish and restore forest structure and pattern, forest health, and vegetation composition and diversity. There is a need to increase forest resiliency and sustainability, protect soil productivity, and improve soil and watershed function. Resiliency increases the ability of the ponderosa pine forest to survive natural disturbances such as fire, insect and disease, fire, and climate change (FSM 2020.5).

- Nonforested openings (interspaces), tree group size, and shape would be determined by the location of less than 8-inch d.b.h. trees. In situations where the existing condition is dominated by trees greater than 8-inch d.b.h., the post-treatment condition would result in large, continuous tree groups with very little variety in size or shape and very little interspace. The post-treatment condition would not move the project area toward forest structure and pattern desired conditions.

- Treatment of approximately 147, 947 acres of VSS 3 stands (with an average diameter larger than 8 inches) and 227,042 acres of VSS 4 to VSS 6 (all stands identified for mechanical treatment) would be constrained by an 8-inch d.b.h. limit. These stands would not be treated or would have minimal treatment. Approximately 73 percent of the 512,178 acres of ponderosa pine within the project area would not move toward desired conditions for forest structure and pattern. In both the short (up to 10 years) and long term (20-plus years) these areas would continue on a trajectory away from the desired forest structure.
- In northern goshawk habitat, the project area currently has an imbalance of tree size classes. In terms of landscape ecology, each size class represents specific habitat components that are needed for goshawk prey species. An imbalance in these habitat components potentially decreases the ability of goshawks to maintain their population numbers over time. Currently, the project area is deficit of mature and old forest (VSS 5 and 6), as well as seedlings and saplings (VSS 2).
- Even-aged stand conditions apply to 46 percent of landscapes outside of post-fledgling area (LOPFA) habitat (see chapter 1). Forest plan direction is to move these areas toward an uneven-aged condition. Constraining treatments within even-aged LOPFA habitat to 8-inch d.b.h. would result in over 80 percent (VSS 3 with an average diameter greater than 8 inches, all VSS 4, 5, and 6) of these acres remaining even-aged. This would be contrary to moving toward improved forest structure and pattern desired conditions which affect habitat.
- Uneven-aged stand conditions apply to 54 percent of the LOPFA habitat (see chapter 1 and the silviculture report). In those portions of the habitat that are currently uneven-aged, VSS 3 (35 percent) and VSS 4 (32 percent) are overrepresented and VSS 1 (0 percent), VSS 2 (2 percent), VSS 5 (14 percent), and VSS 6 (17 percent) are underrepresented (relative to a balanced age/structure uneven-aged condition). In uneven-aged stands, concentrating all treatment to 8-inch d.b.h. and less would result in no movement toward a balance of age classes within over 90 percent (VSS 3 with an average diameter greater than 8 inches, all VSS 4, 5, and 6) of the uneven-aged LOPFA habitat.
- In ponderosa pine (analysis area extent), young and mid-age structural stages (VSS 3 and VSS 4) account for approximately 82 percent of the ponderosa pine project area while the grass/forb and seedling/saplings stages (VSS 1 and VSS 2) are approximately 2 percent, the mature tree stage (VSS 5) is 10 percent, and the old forest stage (VSS 6) is 6 percent. The low representation in the seedling/sapling, mature, and old classes indicates limited structural stage diversity across the landscape (silviculture report, page 27). In many situations, VSS 3 and VSS 4 are in direct competition with the remaining pre-settlement trees (old forest). This intertree competition has a negative effect on old tree growth and vigor resulting in density-related mortality, decreased resilience, and an unsustainable condition. This would be contrary to the need to improving resiliency and sustainability.

Removal of the younger trees competing with the old trees would be determined by the location of trees less than 8-inch d.b.h. VSS 3 (greater than 8 inches) and VSS 4 classes would continue to dominate the landscape and remain in direct competition with the old trees. Movement toward the desired condition is not likely to occur in 199,536 acres (39 percent) of VSS 3 and 221,101 acres (43 percent) of VSS 4 (see the 3A to 3C rows in table 6 of the silviculture report). This condition would be contrary to moving toward forest structure and pattern desired conditions.

- Approximately 374,989 acres of VSS 3 and 191,715 acres of VSS 4, 5, and 6 currently have a stand density index (SDI) greater than 55 percent of maximum SDI, the threshold for density-related mortality in ponderosa pine. There would be limited ability to reduce the potential for density-related mortality on 566,704 acres in areas dominated by trees greater than 8-inch d.b.h. with an SDI greater than 55 percent of maximum SDI. This condition would be contrary improving forest resiliency and sustainability.
- **Gambel oak –** Ponderosa pine trees are the primary factor inhibiting Gambel oak development within 65,024 acres of MSO restricted other habitat. Sixty-two percent of these acres are dominated by trees greater than 8 inches with a SDI greater than 55 percent[6]. Mechanical treatment constrained by an 8-inch limit would not move Gambel oak toward (vegetation composition and diversity) desired conditions in terms of increasing oak growth rates and reducing density-related mortality on approximately 40,315 acres of MSO restricted other habitat.
- **Aspen –** Mechanical treatments up to 8-inch d.b.h. that reduce pine-aspen competition would maintain the aspen overstory and promote aspen regeneration. However, in areas that are dominated by trees greater than 8-inch d.b.h., mechanical treatment constrained to an 8-inch d.b.h. would have very little ability to increase the aspen growth rate or stimulate regeneration and move aspen toward desired conditions for vegetation composition and diversity.
- **Grasslands –** In 11,230 acres of historic (mollisol soils) grassland within the ponderosa pine cover type, 9,435 acres (84 percent) are dominated by trees greater than 8 inches d.b.h. Mechanical treatment constrained by an 8-inch limit would not adequately move grasslands toward (vegetation composition and diversity) desired conditions by restoring historic tree pattern and density.
- **Pine-sage –** Within the 5,261 acres of pine-sage proposed for mechanical treatment, 5,187 acres (99 percent) are dominated by trees greater than 8 inches. Mechanical treatment constrained by an 8-inch limit is not expected to adequately move pine-sage toward (vegetation composition and diversity) desired conditions by restoring the historic tree pattern and density.

Summary: This alternative would partially address Issue 2, conservation of large trees, since mechanical treatments would be curtailed at 8-inch d.b.h. It would not achieve restoration desired conditions. It would resolve Issue 3, post-treatment canopy cover and landscape openness, since only small-diameter trees would be removed. However, approximately 73 percent of the 512,178

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[6] Based upon established forest density/vigor relationships, density-related mortality begins to occur once the forest reaches 45 to 50 percent of maximum stand density and mortality is likely at density levels of 60 percent+ of maximum stand density. See chapter 1 of the DEIS and the silviculture report for additional information on stand density.

acres of ponderosa pine within the project area would not move toward forest structure and pattern desired conditions. Of all the even-aged stands, 47 percent (VSS 4), 8 percent (VSS 5), and 1 percent (VSS 6) would remain even-aged. There would be zero percent movement toward desired conditions in uneven-aged VSS 4 through VSS 6. For these reasons, this alternative was considered but eliminated from detailed study.

Utilize Prescribed Fire as the Sole Treatment Method

In response to public comments and recommendations, we considered an alternative which only uses prescribed fire to move toward restoration desired conditions. The recommendations are based on the assertion that the current high-intensity fire rotation in southwestern forests is 625 years and/or that the forests should be predominantly managed as self-regulating through the use of natural processes such as fire. This alternative was not analyzed in detail. After an initial analysis, it was determined that it would not meet various elements of the purpose and need, as described below. The purpose and need statement is displayed in **bold** text.

The purpose of the project is to reestablish and restore forest structure and pattern, forest health, and vegetation composition and diversity. There is a need to increase forest resiliency and sustainability, protect soil productivity, and improve soil and watershed function. Resiliency increases the ability of the ponderosa pine forest to survive natural disturbances such as fire, insect and disease, fire, and climate change (FSM 2020.5).

PACs are representative of old age, old forest structure within the project area. Figure 25 shows heavy fuel loading within a PAC. This is representative of conditions within some PACs in the project area that are proposed for treatment. In this location, litter is 8 to 12 inches deep. There are several inches of duff beneath the litter and large logs scattered about. Some logs are buried in the litter. There is a preponderance of young trees, with sufficient canopy fuels to carry active crown fire. In areas like this, it would be difficult to reduce surface fuels by thinning with fire without killing large and old trees.

Figure 25. High surface fuel loadings in Mormon Mountain PAC (2001), Coconino NF

Using fire as a thinning agent in these conditions would cause high-severity effects to the surface and/or result in uncontrollable fire behavior. This represents extreme fuel loading and is a hazardous condition which can produce high-severity effects. If a wildfire burned though this PAC (even under moderate conditions), the effect would be high tree mortality, loss of soil productivity, and the total loss of nesting and roosting habitat. This would be contrary to the need to improve resiliency and sustainability in the project area.

Based on the potential for severe fire effects, using prescribed fire in 18 PACs (without the ability to mechanically protect old and large trees) would likely be deferred. No movement toward reducing fire risk or improved quality in nesting and roosting habitat (as described in the desired conditions from forest plans and from MSO recovery plan objectives) would occur in 10,741 acres (acres to be mechanically treated up to 18-inch d.b.h.) of MSO habitat. Movement toward a forest that is resilient to natural disturbances would be diminished. Without resiliency, forest sustainability would be affected:

- Old ponderosa pines are often more susceptible to mortality after fire (even low-intensity fires) than younger mature trees (Kolb et al. 2007). The increasing size and severity of wildfires and the ensuing death of old and/or large ponderosa pines has been linked to fuel accumulation resulting from a century of fire exclusion (Covington et al. 2001, Hood 2010, and Kolb et al. 2007). In order to avoid excessive old tree damage and mortality, any treatment in those acres that contribute to old growth allocation (194,804 acres of 593,211 acres or 33 percent of the treatment area) would likely be deferred in order to avoid a further reduction in pre-settlement trees, which are currently uncommon across the landscape. In this alternative, movement toward having a sustainable forest structure with age and size class diversity would not be met as there would be continued overrepresentation in the VSS 3 and 4 age classes and continued underrepresentation in the VSS 5 and VSS 6 age classes.
- Within 27 percent (159,211 acres of 593,211 acres) of the treatment area, a prescribed fire only alternative would meet forest structure desired conditions because there is little need for changing forest structure on these acres. On the remaining 434,000 acres, analysis indicates mechanical treatment would be needed to move toward forest structure desired conditions.
- The project area is currently deficit in VSS 1 and VSS 2 (2 percent of the project area). Using prescribed fire only would not provide the adequate regeneration opening necessary to move toward the desired condition of a balance of age classes without producing high mortality in VSS 5 and VSS 6. The project area is currently deficit in mature tree stage (VSS 5) and the old forest stage (VSS 6) is 10 and 6 percent of the project area respectfully. Using prescribed fire only would not increase growth in mid-aged stands to move sites toward mature and old forests. It would not meet forest structure and pattern desired conditions.
- The use of prescribed fire without mechanical treatment could result in undesirable fire effects in goshawk habitat as stand density increases over time. In 2020, both even-aged and uneven-aged stands that occur in LOPFAs are projected to be dominated by the young and mid-aged forest structural stage, approximately twice the desired condition (see the silviculture report). Trends in goshawk PFAs are similar as described for LOPFAs. This would not meet forest structure and pattern desired conditions and would not move improve resiliency in goshawk habitat.

- Fires in areas dominated by dense, even-aged VSS 3 and VSS 4 severe enough to thin trees are likely to result in crown fires and would be difficult to manage under any circumstances (Miller and Urban 2000). Under these conditions, there is an elevated potential for fire to be carried into the overstory canopy or for fire to damage tree cambium to the point of overstory mortality beyond what is acceptable (Battaglia, Smith, and Shepperd 2009).
- Up to 76 percent (303,721 acres) of goshawk LOPFA would not be expected to move toward the desired condition of having a forest structure with age class diversity. In areas dominated by VSS 3 and VSS 4, the tree size would be greater than what could be safely and effectively treated with fire. Due to the likelihood of severe fire effects, prescribed fire treatments are likely to be deferred in the larger VSS classes. The post-treatment condition would result in large, continuous tree groups with very little variety in size or shape and very little interspace. A lack of groups with interspaces would increase the likelihood of having future overstory mortality as a result of using prescribed fire only. Compliance with forest plan goshawk habitat requirements that restrict the width and acre size of openings would be unpredictable.
- In pine-sage, prescribed fire would need to be deferred in areas where pine cover is highest in order to avoid severe effects to the surface vegetation community. Movement toward the (vegetation composition and diversity) desired condition by restoring the historic pattern within the pine-sage mosaic and managing fire in sage would not be achieved in the deferred acres or in areas where treatments led to severe effects to surface vegetation.
- Within 11,230 acres of historic (mollisol soils) grassland within the ponderosa pine cover type, and the 45,469 acres of historic (mollic-integrade) savanna, about 48,332 acres (85 percent) are dominated by trees in the VSS 3 and larger classes. On these acres, there would very little ability to restore the historic tree pattern and density without removing the encroachment prior to using prescribed fire. Moving toward forest structure, spatial pattern and vegetation composition and diversity desired conditions would not likely to be met under a prescribed fire only scenario. On 48,161 acres of grasslands (grassland cover type), prescribed fire only would not accomplish the objective of removing tree encroachment of other than seedling size trees; fire only would likely produce effects that simulate regeneration and growth of native herbaceous vegetation.
- Areas deferred because of dense forest conditions would maintain closed canopies and prevent understory development, limiting vegetation diversity and composition, particularly for MSO and goshawk prey species.

Summary: This issue would not resolve **Issue 2**, conservation of large trees. This alternative was considered but eliminated from detailed study because: (1) fire risk would remain high and there would be no improvement in terms of resiliency in and around MSO PACs; (2) treatment on 194,804 acres or 33 percent of the treatment area would likely be deferred in order to avoid a further reduction in pre-settlement trees; (3) movement toward having a sustainable forest structure with age and size class diversity would not be met as there would be continued overrepresentation in the VSS 3 and 4 age classes and continued underrepresentation in the VSS 5 and VSS 6 age classes; (4) forest structure and pattern and overall function would not be restored on 11,230 acres of grasslands and 45,469 acres of historic mollic-integrade savanna; and (5) movement toward the desired condition of restoring the historic pattern within the pine-sage mosaic would not be achieved in areas where treatment was deferred.

Eliminate the Use of Prescribed Fire

The purpose of this alternative is to respond to public comment and the recommendation to eliminate all prescribed fire in order to remove project nuisance smoke and its resulting emissions. Recommendations include using livestock (cattle, goats) in lieu of prescribed fire to reduce fuels. This alternative assumes that approximately 90 percent of all treatment-related slash (biomass) would be moved offsite and considers grazing and a variety of mechanical treatment methods to reduce fuels.

This alternative was not analyzed in detail. After an initial analysis, it was determined that it would not meet various elements of the purpose and need, as described below. The purpose and need statement is displayed in **bold** text.

The purpose of the project is to reestablish and restore forest structure and pattern, forest health, and vegetation composition and diversity. There is a need to increase forest resiliency and sustainability, protect soil productivity, and improve soil and watershed function. Resiliency increases the ability of the ponderosa pine forest to survive natural disturbances such as fire, insect and disease, fire, and climate change (FSM 2020.5).

- Without the use of prescribed fire, forest structure could be affected in terms of moving toward age and size class diversity and forest health desired conditions. Without the thinning effect of fire, denser conditions could affect the VSS distribution trend by slowing stand development and growth. This would result in more of the landscape being maintained in the young forest stage. Contrary to the restoration purpose and need, development of the mature and old forest stages could be impeded.
- Mechanical treatments would address the majority of conditions associated with density-related mortality, bark beetle hazard, and dwarf mistletoe infections. However, the pruning effect of fire sanitizing dwarf mistletoe infections would not be realized nor would reduced densities due to the thinning effect of fire be realized. This could lead to slight increases in bark beetle hazard and density-related mortality, contrary to resiliency and sustainability desired conditions.
- Without the use of prescribed fire, patterns of surface vegetation would continue to deteriorate as fire-adapted shrubs and herbaceous species decline (Huffman and Moore 2008, Moir 1988). Eliminating fire would also have an effect on Gambel oak growth forms and densities. Currently, the Gambel oak population throughout the project area is dominated by seedlings and saplings. Without fire as a regulator of these smaller size classes, both the variety of oak growth forms and densities of seedlings and saplings would continue to be outside the range of oak’s evolutionary environment. This would be contrary to forest structure, pattern, and vegetation composition and diversity desired conditions.
- Mechanical treatment on 434,001 acres in the project area would be effective at restructuring canopy bulk density, canopy base heights, tree density, and the arrangement of trees in the short term (immediately post-treatment). However, mechanical treatments alone would not be sufficient to produce effects that simulate regeneration and growth of native herbaceous understory vegetation (vegetation

composition and diversity desired condition) or reduce the natural surface fuels that have accumulated since the interruption of fire on the landscape. Refer to the alternative D effects analysis in chapter 3 for a detailed example of the effects of eliminating prescribed fire as a restoration treatment.

- In this alternative, accumulations of litter, duff, existing dead and down woody debris, seedlings, and small saplings would not be reduced by mechanical thinning. These accumulations, in addition to the debris from logging (even with most biomass moved offsite), could result in surface fires that burn at high intensities and lethally scorch tree crowns.
- Excessive surface fuels would promote surface fires that are likely to burn at high intensities and have effects that include the mortality of large and old trees on 62 percent or greater of the project area. In the project area, the potential to compromise water resources such as Oak Creek, Upper Lake Mary, or Mormon Lake would exist as second order fire effects occur (flooding, debris flows, erosion, etc.). This would be contrary to the need to reduce the potential for severe fire effects and move toward having a forest that is resilient to wildfire.
- Other types of mechanical fuels treatments considered include:
    - Debris from chipping and shredding of trees and woody surface fuels would either remain on the forest floor or would be piled and moved offsite. Shredded or chipped wood at the surface has been shown to augment the already negative effects of excessive litter/duff that has accumulated, decreasing surface vegetation cover, particularly for native species (Miller and Seastedt 2004). Therefore, most materials would need to be piled and moved off the forests.
    - Mastication of trees and woody surface fuels produces a much wider variety of debris sizes. When the mastication debris is left on the forest floor, it does not cover the forest floor as completely as using the chipping method. Nonetheless, as with chipping, when the size of the project and the potential quantity of material to be masticated is considered, mastication would only be viable if debris is consolidated and removed.
    - Raking is a time-consuming method that is a way to treat the buildup of litter and duff. Leaf blowing would be a time-consuming method that would not be effective at removing a buildup of litter and duff. This method could be combined with raking as it may facilitate moving litter into piles which are then transported off the forests.
    - Grazing as another method to reduce fuel loading that was suggested in public comment. Grazers would remove the herbaceous vegetation that helps carry a fire across the majority of the project area, but the herbaceous layer is only a minor contributor to fire effects when compared to needle cast, tree debris, and the trees themselves. Grazing to reduce fuel loading is much more effective in chaparral and scrubland habitats, which are rare within the project area.
    - Within the larger 988,764-acre 4FRI project area, 791,250 acres are within grazing allotments. There are 47 active livestock (cattle and sheep) allotment management plans in place. The allotment plans address suitable forage areas and are designed to maintain or improve forest resources. These plans have conservative grazing utilization standards that range between 30 and 40 percent. Grazing systems include

both rest and deferred rotation. The use of these grazing systems can temporarily reduce herbaceous fine fuels where grazing occurs. However, this use is not even throughout a pasture and the herbaceous vegetation and shrubby fuels regrow, normally within the same year.

- To replace the use of prescribed fire, livestock (cattle and goats) would have to be used on 593,211 acres (alternative C). Utilization rates would need to be greatly increased along with the length of graze periods within each pasture. This type of increased use would exceed what is currently permitted in the existing allotment management plans. There would likely be a decline in herbaceous species production and diversity, and possibly an increase in soil compaction across the project area. This is contrary to the purpose and need which is designed to increase the herbaceous understory and move toward improved function in soils, watersheds, grasslands, and forested areas.

Summary: This issue would resolve **Issue 1**, prescribed fire emissions. It would be possible to use mechanical treatments to move biomass offsite and reduce surface fuels that would have been burned and produced smoke. However, mechanical treatment would not replace the role fire has in improving vegetation composition and diversity on: (1) 59,391 acres of existing grasslands, (2) over 56,000 acres of ponderosa pine with a savanna or grassland reference condition, (3) grassland inclusions within 308,000 acres of ponderosa pine forested areas, (4) 5,261 acres of pine-sage, (5) 1,471 acres of aspen, and (6) thousands of acres where Gambel oak exists within the pine forest.

Without the ability to use prescribed fire to: (1) stimulate understory vegetation growth, (2) reduce the natural surface fuels (that have accumulated since the interruption of fire on the landscape), and (3) maintain desired canopy base heights, canopy bulk densities, and reduced ladder fuel conditions (that were attained through mechanical treatment), it is estimated the project area would begin to move away from forest structure and pattern and resiliency desired conditions within 10 years of the mechanical treatment. The use of alternative fuels treatment methods in lieu of prescribed fire could provide reductions in fuels but would not meet the ecological need of a fire-adapted landscape. In the case of grazing, the level that would be needed to maintain the project area without fire would exceed forest plan allowable thresholds. Using grazing as a surrogate for prescribed fire would be contrary to the purpose and need which is designed to increase vegetation composition and diversity, and move toward improved soil productivity and watershed function.

Incorporate the Original Large Tree Retention Strategy (LTRS)

Overview: This alternative was not analyzed in detail. After an initial analysis, it was determined that incorporating/implementing the original LTRS would not meet various elements of the purpose and need. A modified version of the original strategy, the large tree implementation plan (LTIP), was included in alternative C. The “background” section summarizes how the original LTRS was modified. Table 15 displays a few excerpts from the original LTRS, the location of the excerpts in the LTRS, a crosswalk to the modified LTIP, and rationale why the original language was not accepted as written. The complete crosswalk document is in the project record and will be made available on the 4FRI Web site.

Background: The large tree retention strategy (hereafter referred to as LTRS) was developed by the four-forest restoration stakeholders in 2011 through a collaborative process. The intent of the LTRS exception process is to increase landscape heterogeneity and conserve biodiversity. The LTRS represents social agreement between parties and was developed to reduce conflict and enhance the chance of successfully implementing restoration at the landscape scale. The original LTRS defines large post-settlement trees as those greater than 16-inch diameter-at-breast height (d.b.h.). The LTRS provides direction for retaining large trees throughout the 4FRI landscape, except:

- As necessary to meet community protection and public safety goals, and
- Where best available science and stakeholder agreement identify sites where ecological restoration and biodiversity objectives cannot otherwise be met. This specifically applies to several exception categories including wet meadows, seeps, springs, riparian areas, encroached grasslands, aspen groves or oak stands, within stand openings, and heavily stocked stands with high basal area generated by a preponderance of large, young trees.

Rationale for Considering but Eliminating the Original LTRS from Detailed Study:

- The original LTRS did not provide the ability to create regeneration openings using a group selection treatment method within the large, young tree (LTRS, pp. 23–24) and the within stand openings category (LTRS, pp. 21–22). We found that in the short term (0 to 10 years), this would result in a continued imbalance of size classes that would be contrary to the forest plan desired conditions in non-PFA goshawk habitat outside of nest stands. There would be no movement toward sustaining the older, larger trees into the future. The ability to provide for tree recruitment into the largest size classes would be hindered. For this reason, the implementation plan includes the ability to create regeneration openings.
- The original LTRS would have required the Forest Service to consult with stakeholders should a new exception category be found during implementation (LTRS, page 25). To resolve the potential for Federal Advisory Committee Act (FACA) violations, this consultation requirement was removed. The modified version includes language to address the concern without potentially violating FACA: During implementation (prescription development), if a condition exists that does not the meet the desired conditions included in the large tree implementation plan, no large trees would be cut until the National Environmental Policy Act (NEPA) decision is reviewed by the Forest Service implementation team. The team would decide whether the action is consistent with the analysis and the decision made. This information would be made part of the annual implementation plan checklist/compliance review that is recommended by the team and approved by the forest supervisor.
- In the original LTRS, movement toward the desired condition in pine-oak was constrained to MSO habitat. This would preclude moving toward desired conditions in non-MSO habitat (LTRS, pp. 19–20). For this reason, the ability to move all pine-oak within the project area toward desired conditions was included in the large tree implementation plan.
- The exception categories were translated into resource-specific desired conditions. This was completed because we found that the exception categories represented the majority of the landscape. An exception, by definition, is something that is not included in, or

does not fit into, a general rule. We spatially mapped the exception categories and found that true exceptions were a minor component of the desired condition strategy for managing post-settlement trees. For example, the geospatial mapping exercise found that around 54,358 acres of the proposed treatment area did not fit an existing resource (formally exception) category. Most acreage could be classified within the large, young tree category. The 54,358 acres noted above do not necessarily mean a new category has to be developed. Either the vegetation and geospatial data was not able to determine what category these acres should be placed in or it was expected, based on the vegetation data, that these acres could be moved toward desired conditions without needing to cut trees larger than 16-inch d.b.h. On-ground review and validation is planned to rectify the lack of information on these acres. Desired conditions were easier to translate into treatment design (see "Alternative C – Implementation Plan"). See table 15 which provides two examples of exception categories modified into desired conditions.

- Other minor additions or variations are disclosed in the January 23, 2012, Summary LTRS Crosswalk to desired conditions document (see project record).

Limit Mechanical Treatments to 16-inch d.b.h. as a Means to Preserve Large Trees

Background: This alternative originated over the impression that there are relatively few large trees remaining on the landscape and that the removal of large trees is a return to commercially-focused forest management.

In the past, within the Southwestern Region of the Forest Service, diameter caps have been used to preserve large trees, often those over 16-inch d.b.h., leading to a so-called "16-inch cap." In many cases, project level agreements were negotiated with local stakeholders to implement diameter caps. Diameter caps have since become a common practice on some national forests within the region. Recent projects on the Coconino NF with some form of diameter caps include Upper Beaver Creek and East Clear Creek. Many other recent projects on the Coconino NF and the southern part of the Kaibab NF have consider but eliminated a "16-inch cap" alternative due to it not meeting these specific projects' purpose and need.

An alternative limiting mechanical harvest to trees less than 16-inch d.b.h. was not analyzed in detail for two reasons:

1. The 4FRI collaborative group developed and submitted to the Forest Service for consideration a large tree retention strategy (LTRS). The LTRS identifies situations where removing post-settlement trees larger than 16-inch d.b.h. would be ecologically beneficial. Key components from the 4FRI stakeholder strategy have been incorporated into alternative C's implementation plan.
2. Land managers and researchers throughout the Southwest have concerns that such a policy is unsustainable, and that constraining restoration treatments to 16-inch d.b.h. and less would limit achievement and maintenance of desired conditions for long-term forest structure, composition, and forest dynamics unique to the open tree canopy/multistoried conditions in the frequent fire forests of Arizona and New Mexico.

Fire-adapted forest systems typical within the Southwestern Region of the Forest Service were historically driven by frequent fire burning through an herbaceous understory. This maintained open, uneven-aged conditions in ponderosa pine and dry mixed conifer forests. The purpose of the project is to reestablish and restore forest structure and pattern, forest health, and vegetation composition and diversity. There is a need to increase forest resiliency, protect soil productivity, and improve soil and watershed function. Resiliency increases the ability of the ponderosa pine forest to survive natural disturbances such as fire, insect and disease, and climate change (FSM 2020.5). In meeting desired conditions, restoration treatments proposed in the 4FRI project are designed to lower the overstory density and canopy continuity, and reestablish forest openings to provide for recruitment of younger age classes.

The publication “Diameter Caps and Forest Restoration” (USDA 2011) documents an evaluation of a 16-inch d.b.h. cut limit on achieving desired conditions and reports on the results of related studies. This publication synthesizes the concerns land managers and researchers throughout the Southwest have regarding a projectwide (programmatic) diameter cap. The main conclusion from that publication is that when managed using a 16-inch d.b.h. cut limit, the plurality of stands would trend toward a large diameter, single story, closed-canopy condition. The ponderosa pine/grassland and the ponderosa pine/Gambel oak potential natural vegetation types (PNVTs) considered in the USDA 2011 study are prevalent throughout the 4FRI project area and some of the forest inventory assessment (FIA) datasets used in the study are from the southern Kaibab NF and Coconino NF.

The following discussion relates how a trend toward a large diameter, single story, closed-canopy forest condition would not meet many of the project’s desired conditions:

- A trend toward a large diameter, single story, closed-canopy forest condition would result in homogeneous vegetation structure at the landscape scale. Structural characteristics would lack a mosaic of interspace, tree groups of varying sizes and forest structure with all age and size classes represented. Forest management under a diameter cap would result in a narrow range of forest structure and composition, thereby limiting future ability to manage for a restored forest condition. For these reasons, the purpose and need would not be met on most of the project area.
- Closed-canopy forests do not allow for the sustainable vigor/growth of old age trees. Under these conditions, old trees would be subject to density-related mortality, higher bark beetle hazard, and would be more susceptible to high-severity fires.
- Closed canopy, single-storied forests are more susceptible to density-related mortality, successful bark beetle attack, and provide conditions conducive to dwarf mistletoe spread and intensification.
- A trend toward single story, closed-canopy forest conditions would result in landscape scale homogeneity lacking diversity. Closed-canopy forest conditions do not allow for the sustainable growth of shade intolerant tree species (Gambel oak and aspen). Closed-canopy forest conditions do not provide canopy gaps to support robust understory vegetation for plant diversity.
- Closed-canopy, single-storied forest stands are more susceptible to crown fires and changes to fire regimes, as well as long-term conversion from forested plant communities to shrub- and herbaceous-dominated vegetation types (Savage and Mast 2005).

Table 15. Large tree retention strategy and large tree implementation plan crosswalk

Original LTRS Statement	LTRS Reference Location	Rationale for Excluding Statement as Written in the (Modified) Large Tree Implementation Plan
Comparison Between Original and (modified) Large Tree Implementation Plan		
The intention of the exception process is to increase landscape heterogeneity and conserve biodiversity. Thus, we do not support implementing any exceptions where removing the trees would conflict with existing recovery/conservation plan objectives for managing sensitive, threatened, or endangered species or their habitat. We also recognize there may be additional areas and/or circumstances where large trees need to be removed to achieve restoration. These circumstances should be identified through a site specific, agreement based, collaborative process as described in the 4FRI Charter.	Page 4 of I. Old Growth Protection and Large Tree Retention Strategy (OGP and LTRS) Overview	This statement in the LTRS requires agreement-based exceptions for categories overlooked in the LTRS. This statement implies the Forest Service (FS) will need to seek approval for every tree cut that may be in an exception not currently covered. The FS cannot relinquish its decisionmaking authority. Additionally; when mapped, the exception categories described in the LTRS are shown to be common occurrences on the ground (they are the norm).
III. Exception Process for Large Post-Settlement Tree Retention The following section outlines a problem statement, specific identifying circumstances, ecological objectives, and selection criteria for instances in which large post-settlement trees may be cut to meet restoration objectives. At specific locations, large trees may need to be removed, felled, or girdled for purposes of ecological restoration and biodiversity conservation. The purpose of this section is to provide sufficient specificity to translate those exception categories where stakeholder agreement exists to do so into management actions and tree marking guidelines. For eight of the nine exception categories, programmatic recommendations describe the circumstances and criteria in which large post-settlement trees may need to be removed. For the “Heavily Stocked Stands with High Basal Area Generated by a Preponderance of Large Young Trees (or Large Young Tree)” exception category, getting to a higher level of social and scientific agreement entails more complexity and challenges, so we propose the initiation of additional collaborative discussion and planning that we hope will bolster restoration efforts by increasing confidence and knowledge sharing, maximizing agreement, and minimizing disagreement.	Exception Process, III. p. 8, also see pp. 9, 11, 13, 15, 17, 19, 21, and 23	The intent of this section (criteria for removing large trees) is addressed in design features (designed to meet forest plan requirements) and the alternative C implementation plan. These pages imply the Forest Service would need to seek approval for every tree cut that may be in an exception category not currently defined. The Forest Service cannot legally give its decisionmaking authority to an individual or group. On a project of this size, it would not be reasonable or practical to seek agreement on all marking when this requires silvicultural expertise. However, the implementation plan in the DEIS reflects collaboration with interested parties. It has been field tested with interested parties from the stakeholder group and with Agency foresters who routinely mark and administer vegetation projects. Modifications were made to the implementation plan as a result of the field reviews. In addition, the implementation plan reflects the incorporation of the stakeholder developed old growth protection strategy. This strategy is presented as the “Old Tree Implementation Plan” and was incorporated into all action alternatives.

Original LTRS Statement	LTRS Reference Location	Rationale for Excluding Statement as Written in the (Modified) Large Tree Implementation Plan
Within Stand Openings Exception Category: **Ecological Objectives** 1. Conserve and restore openings within stands to provide natural spatial heterogeneity for biological diversity. 2. Break up fuel continuity to reduce the probability of torching and crowning. 3. Restore natural heterogeneity within stands. 4. Promote snowpack accumulation and retention to benefit groundwater recharge and watershed processes at small scale. **Criteria** Large (>16″ d.b.h.) post-settlement ponderosa pine trees may be removed to restore the unique biophysical attributes of within stand openings according to these criteria: 1. When the presence of such trees would prevent the reestablishment of sufficient within-stand openings to emulate natural vegetation patterns based on current stand conditions, pre-settlement evidences, desired future conditions, or other restoration objectives, and 2. Where desired openings are tentatively identified as ≥0.05 acre (these openings should be established wherever possible by enlarging current within stand openings or where small diameter trees are predominant), and 3. Where removing the trees does not conflict with existing recovery/conservation plan objectives for managing sensitive, threatened, or endangered species or their habitat. NOTE: It is not necessary that within-stand openings and groups be located in the same location that they were in before settlement. That is, trees might be retained in areas that were openings before settlement, and openings might be established in areas that had previously supported pre-settlement trees.	pp. 21–22	This exception category does not allow cutting trees greater than 16 inches for regeneration openings. Accepting this as written would violate the forest plans and the concept of a balance of age classes and sustained yield. The modified LTIP includes language that allows for regeneration openings and includes desired conditions related to implementing pre-settlement tree conservation measures. For an opening that is equivalent to 3/10 to 8/10 per acre, there could be a situation where you cannot provide the opening without cutting a tree that is greater than 16-inch d.b.h., because group selection is missing from the LTRS. It could force the placement of tree groups in sub-standard locations. The desired conditions for this category are as follows: **Modified Within-Stand Openings Desired Conditions** • The pattern of openings within stands that provide natural spatial heterogeneity for biological diversity are conserved. • Openings break up fuel continuity to reduce the probability of torching and crowning and restore natural heterogeneity within stands. • Openings promote snowpack accumulation and retention which benefits groundwater recharge and watershed processes at the fine (1 to 10 acres) scale. • The presence of such trees does not prevent the reestablishment of sufficient within-stand openings to emulate natural vegetation patterns based on current stand conditions, pre-settlement evidences, desired future conditions, or other restoration objectives. • Groups of trees typically range in size from 0.1 acre to 1.0 acre. Canopy gaps and interspaces between tree groups or individuals are based on site productivity and soil type and range from 10 percent on highly productive sites to as high as 90 percent on those soil types that have an open reference condition. • Suitable openings for successful natural regeneration in this project would range in size from 3/10 to 8/10 of an acre.

Alternatives Considered in Detail

The Forest Service developed four alternatives, including the no action (alternative A), the final proposed action (alternative B), and two additional alternatives (alternatives C and D). Alternatives C and D respond to recommendations and issues raised by the public. A brief summary of the alternatives is provided below.

Alternative A is the no action alternative as required by 40 CFR 1502.14(c). There would be no changes in current management under the forest plans. Approximately 82,592 acres of ongoing vegetation treatments and 96,125 acres of ongoing prescribed fire projects would continue to be implemented adjacent to the treatment area. Approximately 86,771 acres of vegetation treatments and 142,869 acres of prescribed fire and maintenance burning would be implemented adjacent to the treatment area by the forests in the foreseeable future (within 5 years). Alternative A is the point of reference for assessing action alternatives B–D.

Alternative B is the proposed action**.** This alternative would mechanically treat 388,489 acres of vegetation and utilize prescribed fire on 587,923 acres. It incorporates comments and recommendations received during 8 months of collaboration with individuals, agencies, and organizations. It proposes mechanically treating up to 16-inch d.b.h. in 18 MSO PACs and includes low-severity prescribed fire within 72 MSO PACs, including 56 core areas. Three nonsignificant forest plan amendments on the Coconino NF and two nonsignificant forest plan amendments on the Kaibab NF would be required to be in compliance with the plans.

Alternative C is the **preferred alternative.** This alternative would mechanically treat 434,001 acres of vegetation and utilize prescribed fire on 593,211 acres. It responds to Issue 2 (conservation of large trees) and Issue 4 (increased restoration and research). It adds acres of grassland treatments on the Kaibab NF, incorporates wildlife and watershed research on both forests, and mechanically treats and uses prescribed fire within the proposed Garland Prairie Research Natural Area on the Kaibab NF. It proposes mechanically treating up to 18-inch d.b.h. in 18 MSO PACs and includes low-severity prescribed fire within 72 MSO PACs, including 56 core areas. Key components of the stakeholder created LTRS are incorporated into the alternative's implementation plan. Three nonsignificant forest plan amendments on the Coconino NF and three nonsignificant amendments on the Kaibab NF would be required to be in compliance with the plans.

Alternative D would mechanically treat 388,489 acres of vegetation and utilize prescribed fire on 178,790 acres. This alternative was developed in response to Issue 1(prescribed fire emissions). It decreases the acres that would receive prescribed fire by30 percent when compared to alternative B (proposed action). It proposes mechanically treating up to 16-inch d.b.h. in 18 PACs MSO PACs but the PACs would not be treated with prescribed fire. Three nonsignificant forest plan amendments on the Coconino NF and two amendments would be required on the Kaibab NF to be in compliance with the plans.

Actions Common to Alternatives B–D

- All action alternatives (B–D) propose additional actions including restoring springs and ephemeral channels, constructing protective fencing in select aspen stands, constructing (and decommissioning) temporary roads, reconstructing and improving roads, relocating a minimal number of road miles, and decommissioning existing roads and unauthorized routes (see table 1 in chapter 1).

- Design features, best management practices (BMPs), and mitigation to be used as part of alternatives B–D are located in appendix C.
- All action alternatives incorporate key components of the old tree protection strategy into the alternative's design features (appendix C), implementation plan (appendix D), and monitoring and adaptive management (appendix E). The Forest Service worked collaboratively with stakeholders to develop the monitoring and adaptive management and implementation plan.
- All action alternatives include adaptive management actions that would be taken as needed to restore springs, ephemeral channels, and naturalize decommissioned and unauthorized roads (table 16).
- All action alternatives address Issue 3, post-treatment canopy cover and landscape openness. Alternatives B–D are designed to meet canopy cover in VSS 4 to VSS 6 in compliance with the forest plans (except in areas managed for an open reference condition). Each alternative addresses the interrelationship between canopy cover and old and large trees.

Alternative B – Proposed Action

The Coconino and Kaibab NFs propose to conduct approximately 587,923 acres of restoration activities over approximately 10 years or until objectives are met. Up to 45,000 acres of vegetation would be mechanically treated annually. Up to 40,000 acres of prescribed fire would be implemented annually across the forests. Two prescribed fires[7] would be conducted on all acres proposed for treatment over the 10-year period. Restoration activities would:

- Mechanically cut trees and apply prescribed fire on approximately 388,489 acres. This includes: (1) mechanically treating up to 16-inch d.b.h. within 18 MSO PACs, (2) cutting 99 acres of trees by hand on slopes greater than 40 percent, and (3) using low-severity prescribed fire within 72 MSO PACs (excluding core areas).
- Utilize prescribed fire only on approximately 199,435 acres.
- Construct 517 miles of temporary roads for haul access and decommission when treatments are complete (no new permanent roads would be constructed).
- Reconstruct up to 40 miles of existing, open roads for resource and safety concerns (no new permanent roads would be constructed). Of these miles, approximately 30 miles would be improved to allow for haul (primarily widening corners to improve turn radiuses) and about 10 miles of road would be relocated out of stream bottoms. Relocated roads would include rehabilitation of the moved road segment.
- Decommission 770 miles of existing system and unauthorized roads on the Coconino NF.
- Decommission 134 miles of unauthorized roads on the Kaibab NF.
- Restore 74 springs and construct up to 4 miles of protective fencing.
- Restore 39 miles of ephemeral channels.
- Construct up to 82 miles of protective (aspen) fencing.

[7] The first prescribed fire may include pile burning followed by a broadcast burn.

- Allocate as old growth 40 percent of ponderosa pine and 77 percent of pinyon-juniper woodland on the Coconino NF and 35 percent of ponderosa pine and 58 percent of pinyon-juniper on the Kaibab NF.

Three nonsignificant forest plan amendments (see appendix B) would be required on the Coconino NF to implement alternative B:

Amendment 1 would add language to allow mechanical treatments up to 16-inch d.b.h. to improve habitat structure (nesting and roosting habitat) in 18 MSO PACs. The amendment would remove language that limits PAC treatments in the recovery unit to 10 percent increments and language that requires the selection of an equal number of untreated PACs as controls. The amendment would remove language referencing monitoring (pre- and post-treatment, population, and habitat). Replacement language would defer final project design and monitoring to the FWS biological opinion specific to MSO for the project.

The amendment, which is specific to restricted habitat in pine-oak, would allow for designating less than 10 percent of restricted habitat on the Coconino NF as target or threshold (i.e., future nesting and roosting habitat) based on the quality of the habitat. Definitions of target and threshold habitat would be added.

Amendment 2 would add the desired percentage of interspace within uneven-aged stands to facilitate restoration in goshawk habitat (excluding nest areas), add the interspace distance between tree groups, add language clarifying where canopy cover is and is not measured, allow 29,017 acres to be managed for an open reference condition, and add a definition to the forest plan glossary for the terms interspaces, open reference condition, and stands.

Amendment 3 would remove the cultural resource standard that requires achieving a “no effect” determination and would add the words “or no adverse effect” to the remaining standard. In effect, management would strive to achieve a “no effect” or “no adverse effect” determination.

Two nonsignificant forest plan amendments (see appendix B) would be required on the Kaibab NF to implement alternative B:

Amendment 1 would add the desired percentage of interspace within uneven-aged stands to facilitate restoration in goshawk habitat (excluding nest areas), add the interspace distance between tree groups, add language clarifying where canopy cover is and is not measured, allow 27,637 acres to be managed for an open reference condition, and add a definition to the forest plan glossary for the terms interspaces, open reference condition, and stands.

Amendment 2 would allow for designating less than 10 percent of restricted habitat in pine-oak as target or threshold (i.e., future nesting and roosting habitat) based on the quality of the habitat. The amendment would remove language that limits PAC treatments in the recovery unit to 10 percent increments and requires the selection of an equal number of untreated PACs as controls. The amendment would also remove language that references monitoring (pre- and post-treatment, population and habitat). Replacement language would defer final project design and monitoring to the FWS biological opinion specific to MSO for the project.

Table 16. Alternative B–D springs, channels, and roads adaptive management actions

Evaluation Criteria	Desired Condition	Existing Condition	Possible Management Actions*	Monitoring Measure	Trigger Indicating Additional Action is Needed (What/When)	Adaptive Options*
Roads and unauthorized routes located in upland (non-meadow) and in meadows	Soils are in satisfactory condition so that soil can resist erosion, recycle nutrients, and absorb water. Understory species (grasses, forbs, and shrubs) diversity is consistent with site potential and provides for infiltration of water and reduction of accelerated erosion. The understory has a variety of heights of cool and warm season vegetation.	Up to 904 miles of road/route are in unsatisfactory soil condition due to accelerated erosion, lack of effective ground cover, and compaction.	1. Reestablish former drainage patterns, stabilize slopes, and restore vegetation; 2. Block the entrance to a road or install water bars; 3. Remove culverts, reestablish drainages, remove unstable fills, pull back road shoulders, and scatter slash on the roadbed; 4. Eliminate the roadbed by restoring natural contours and slopes; and 5. Other methods designed to meet the specific conditions associated with the unneeded road.	• Miles of road treated • Soil condition assessme nt	Soil condition is impaired or unsatisfactory as defined in a soil condition assessment. Time is 5 years after treatment.	• Additional drainage • Additional revegetation efforts (including mulching) • Short-term fencing to protect revegetation • Complete removal of roadbed
Roads and unauthorized routes located in the filter strips of identified riparian and nonriparian stream courses	Soils are in satisfactory condition so that the soil can resist erosion, recycle nutrients, and absorb water. Understory species (e.g., grasses, forbs, and shrubs) diversity is consistent with site potential and provides for infiltration of water and reduction of accelerated erosion. The understory has a variety of heights of cool	All roads are in unsatisfactory soil condition due to accelerated erosion, lack of effective ground cover, and compaction.	1. Reestablish former drainage patterns, stabilize slopes, and restore vegetation; 2. Block the entrance to a road or install water bars; 3. Remove culverts, reestablish drainages, remove unstable fills, pull back road shoulders, and scatter slash on the roadbed; 4. Eliminate the roadbed by restoring natural contours and slopes; and	• Miles of road treated • Soil condition assessme nt	Soil condition is impaired or unsatisfactory as defined in the soil condition assessment. Time is 5 years after treatment.	• Additional drainage • Additional revegetation efforts (including mulching) • Short-term fencing to protect revegetation

Evaluation Criteria	Desired Condition	Existing Condition	Possible Management Actions*	Monitoring Measure	Trigger Indicating Additional Action is Needed (What/When)	Adaptive Options*
	and warm season vegetation.		5. Other methods designed to meet the specific conditions associated with the unneeded road.			
Undeveloped spring in a forested setting. Vegetation and soils range from satisfactory condition (waterflow is occurring) to vegetation/ soils are below potential or are impaired/ unsatisfactory (there is no evidence of waterflow from spring).	Springs and associated streams and wetlands have the necessary soil, water, and vegetation attributes to be healthy and functioning at or near potential. Waterflow patterns, recharge rates, and geochemistry are similar to historic levels and persist over time. Water quality and quantity maintain native aquatic and riparian habitat and water for wildlife and designated beneficial uses, consistent with water rights and site capability. Plant distribution and occurrence are resilient to natural disturbances. Soils are in satisfactory condition.	Undeveloped springs occur on both forests in a forested setting. There are six springs on the Coconino NF that are located in forested areas, but the status of development is unknown.	If vegetation/soils are satisfactory options include: • Remove tree canopy to pre-settlement condition within 2–5 chains of the spring; • Apply for water right if none exists; • Prescribe burn, or • No action. If vegetation/soils are below potential or are impaired/unsatisfactory options include: • Remove tree canopy to pre-settlement condition within 2–5 chains of the spring; • Apply for water right if none exists; • Remove noxious weeds; • Prescribe burn; or • Identify stressor and provide protection	Properly functioning condition (PFC), Museum of Northern Arizona level 1 monitoring, waterflow (possible new direction for spring monitoring from FS), photo points	Drop in PFC class, monitoring displays a dropping trend. Monitoring every 1–10 years	• ID stressor, protect from stressor (fence/ jackstraw, close road, relocated road, etc.) • No action

Evaluation Criteria	Desired Condition	Existing Condition	Possible Management Actions*	Monitoring Measure	Trigger Indicating Additional Action is Needed (What/When)	Adaptive Options*
			measure for the stressor (fence, jackstraw, remove/relocate road/trail etc.) and/or • Other methods designed to meet the desired conditions.			
Developed springs in a forested setting. Vegetation and soils range from satisfactory condition (waterflow is occurring) to vegetation/ soils are below potential or are impaired/ unsatisfactory (there is no evidence of waterflow from spring).	Springs and associated streams and wetlands have the necessary soil, water, and vegetation attributes to be healthy and functioning at or near potential. Waterflow patterns, recharge rates, and geochemistry are similar to historic levels and persist over time. Water quality and quantity maintain native aquatic and riparian habitat and water for wildlife and designated beneficial uses, consistent with water rights and site capability. Plant distribution and occurrence are resilient to natural disturbances. Soils are in satisfactory condition.	There are 26 springs on the Kaibab NF that are located in forested areas and the status of development is unknown. There are 40 developed springs on the Coconino NF that are located in forested areas. There are six springs on the Coconino NF that are located in forested areas and the status of development is unknown.	Negotiate with holders of water rights that are non-Forest Service at Alto, Chimney, Dairy, Double, Garden, Griffiths, Howard, Little Elden, Lower Hull, Mud, Pat, Sawmill, Seven Anchor, and Upper Hill Springs on the Coconino National Forest and springs on the Kaibab NF to explore the possibility of releasing water above their water right for riparian conditions. If vegetation/soils are below potential or are impaired/unsatisfactory: • Remove tree canopy to pre-settlement condition within 2–5 chains of the spring, • Prescribe burn, • Remove existing water right (see list above) to expand current riparian	PFC, Museum of Northern Arizona level 1 monitoring, waterflow (possible new direction for spring monitoring from FS), photo points	Drop in PFC class, monitoring displays a dropping trend. Monitoring every 1–10 years	• ID stressor, protect from stressor (fence/ jackstraw, close road, relocated road, etc.) • No action

Evaluation Criteria	Desired Condition	Existing Condition	Possible Management Actions*	Monitoring Measure	Trigger Indicating Additional Action is Needed (What/When)	Adaptive Options*
			conditions, • Identify stressor and provide protection measure for the stressor (fence, jackstraw, remove/relocate road/trail etc.), and/or • Apply other methods designed to meet the desired conditions.			
Undeveloped spring in a meadow setting. Vegetation and soils range from satisfactory condition (waterflow is occurring) to vegetation/ soils are below potential or are impaired/ unsatisfactory (there is no evidence of waterflow from spring).	Springs and associated streams and wetlands have the necessary soil, water, and vegetation attributes to be healthy and functioning at or near potential. Waterflow patterns, recharge rates, and geochemistry are similar to historic levels and persist over time. Water quality and quantity maintain native aquatic and riparian habitat and water for wildlife and designated beneficial uses, consistent with water rights and site capability. Plant distribution and occurrence are resilient to natural	Springs occur on the two national forests that are not developed and occur in a meadow setting. There is one spring on the Coconino NF (Scott Spring) that is located in meadow areas, but the status of development is unknown. There is one spring on the Kaibab NF that is located in meadow areas, but the status of	If vegetation/soils are satisfactory: • Apply for water right if none exists, • Prescribe burn, and/or • Take no action. If vegetation/soils are below potential or are impaired/unsatisfactory: • Apply for water right if none exists, • Remove noxious weeds, • Prescribe burn, • Identify stressor and provide protection measure for the stressor (fence, jackstraw, remove/relocate road/trail etc.), and/or	PFC, Museum of Northern Arizona level 1 monitoring, waterflow (possible new direction for spring monitoring from FS), photo points	Drop in PFC class, monitoring displays a dropping trend. Monitoring every 1–10 years	• ID stressor, protect from stressor (fence/ jackstraw, close road, relocate road, etc.) • No action

Evaluation Criteria	Desired Condition	Existing Condition	Possible Management Actions*	Monitoring Measure	Trigger Indicating Additional Action is Needed (What/When)	Adaptive Options*
	disturbances. Soils are in satisfactory condition.	development is unknown.	select • Other methods designed to meet the desired conditions.			
Developed spring in a meadow setting. Vegetation and soils range from satisfactory condition (waterflow is occurring) to vegetation/ soils are below potential or are impaired/ unsatisfactory (there is no evidence of waterflow from spring).	Springs and associated streams and wetlands have the necessary soil, water, and vegetation attributes to be healthy and functioning at or near potential. Waterflow patterns, recharge rates, and geochemistry are similar to historic levels and persist over time. Water quality and quantity maintain native aquatic and riparian habitat and water for wildlife and designated beneficial uses, consistent with water rights and site capability. Plant distribution and occurrence are resilient to natural disturbances. Soils are in satisfactory condition.	Springs occur on the two national forests that are developed and occur in a meadow setting. There are four springs on the Coconino NF that are located in meadow areas and are developed.	If vegetation/soils are satisfactory: • Prescribe burn, • Re-plumb spring to allow for water above existing water right to be released to expand current riparian conditions, and /or • Other methods designed to meet the specific conditions associated. If vegetation/soils are below potential or are impaired/unsatisfactory: • Prescribe burn, • Remove noxious weeds, • Re-plumb spring to allow for water above existing water right to be released to expand current riparian conditions, • Identify stressor and provide protection	PFC, Museum of Northern Arizona level 1 monitoring, waterflow (possible new direction for spring monitoring from FS), photo points	Drop in PFC class, monitoring displays a dropping trend. Monitoring every 1–10 years	• ID stressor, protect from stressor (fence/ jackstraw, close road, relocated road, etc.) • No action

Evaluation Criteria	Desired Condition	Existing Condition	Possible Management Actions*	Monitoring Measure	Trigger Indicating Additional Action is Needed (What/When)	Adaptive Options*
			measure for the stressor (fence, jackstraw, remove/relocate road/trail etc.), and/or • Other methods designed to meet the desired conditions.			

*Adaptive actions will need to be assessed to evaluate whether they are consistent with the NEPA analysis and decision made.

Alternative B Tables and Figures

Table 17 describes treatments and provides treatment acres. Figure 26 displays the general locations of mechanical and prescribed fire treatments.

Table 18 provides acres by road treatment type and restoration unit. Figure 27 displays the general locations of road treatments.

Table 19 provides acres of springs, channels, and aspen treatments by restoration unit. Figure 28 displays the general locations for these treatments.

Table 20 and table 21 provide treatment type and acres in goshawk and MSO habitat. Figure 29 displays the general treatment locations.

Table 22 and table 23 display the old growth allocation acres by forest, restoration unit, and vegetation type. Figure 30 displays the general location of the old growth allocation.

The map packet in appendix A provides all treatment maps at a larger scale for easier viewing.

Table 17. Alternative B mechanical and prescribed fire treatment descriptions and acres

Treatment Type	Treatment Description/Objective	Acres
Aspen	Mechanical treatment that removes post-settlement conifers within 100 feet of aspen clone; stimulates suckering. Accompanied by prescribed fire.	1,229
Prescribed Fire Only	Prescribed fire would be applied exclusively to move treated areas toward desired vegetation conditions.	199,435
Grassland Restoration	Mechanical treatment that removes encroaching post-settlement conifers and manages for up to 90 percent of the treatment area as grass/forb/shrub using pre-settlement tree evidence as guidance. Accompanied by prescribed fire.	11,185
Intermediate Thin (IT) 10 (10 to 25% interspace)	Mechanical treatment that thins tree groups and establishes interspace adjacent to tree groups to an average of 70–90 square feet of basal area and manages for improved tree vigor and growth by retaining the best growing dominant and codominant trees with the least amount of mistletoe; interspace would occupy 10–55 percent of the treatment area, respectively. Accompanied by prescribed fire.	7,766
Intermediate Thin (IT) 25 (25 to 40% interspace)		11,871
Intermediate Thin (IT) 40 (40 to 55% interspace)		39,189
MSO Threshold	Same as MSO Target	1,894
MSO Target	Intermediate thinning (IT) designed to improve forest health, reduce fire risk, and meet forest density, structure, and species composition requirements. Accompanied by prescribed fire.	6,518
MSO Restricted	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure, irregular tree spacing, a mosaic of interspaces and tree groups of varying sizes. Accompanied by prescribed fire.	65,024
MSO PAC	Mechanical treatment designed to increase tree vigor and health and create canopy gaps to reduce fire risk. Accompanied by prescribed fire.	10,741

Treatment Type	Treatment Description/Objective	Acres
Pine-Sage	Mechanical treatment that restores pre-settlement tree density and pattern using pre-settlement tree evidence as guidance. Accompanied by prescribed fire.	5,261
Savanna (70 to 90% interspace)	Mechanical treatment that restores pre-settlement tree density and pattern, and manages for a range of 70–90 percent of the treatment area as interspace (grass/forb) between tree groups or individual trees using pre-settlement tree evidence as guidance. Treatment would be accompanied by prescribed fire.	45,469
Stand Improvement (SI) 10 (10 to 25% interspace)	Mechanical treatment that establishes tree groups and interspace adjacent to tree groups and manages for improved tree vigor and growth by retaining the best growing dominant and codominant trees within each group; interspace would occupy 10–55 percent of the treatment area, respectively. Treatments would be accompanied by prescribed fire.	1,914
Stand Improvement (SI) 25 (25 to 40% interspace)		6,824
Stand Improvement (SI) 40 (40 to 55% interspace)		12,309
Uneven-aged (UEA) 10 (10 to 25% interspace)	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure and a mosaic of interspaces and tree groups of varying sizes. Interspace would occupy 10–25 percent of the treatment area. Accompanied by prescribed fire.	18,204
Uneven-aged (UEA) 25 (25 to 40 % interspace)	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure and a mosaic of interspaces and tree groups of varying sizes. Interspace would occupy 25–40 percent of the treatment area. Accompanied by prescribed fire.	39,244
Uneven-aged (UEA) 40 (40 to 55% interspace)	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure and a mosaic of interspaces and tree groups of varying sizes. Interspace would occupy 40–55 percent of the treatment area. Accompanied by prescribed fire.	101,044
Wildland-Urban Interface (WUI) Pinyon-Juniper	Mechanical treatment around the community of Tusayan designed to reduce fire risk and meet community wildfire protection plan (CWPP) objective. Accompanied by prescribed fire.	535
Wildland-Urban Interface (WUI) (55 to 70% interspace)	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure, and a mosaic of interspaces and tree groups of varying sizes. Interspace would occupy 55–70 percent of the treatment area. Accompanied by prescribed fire.	2,268

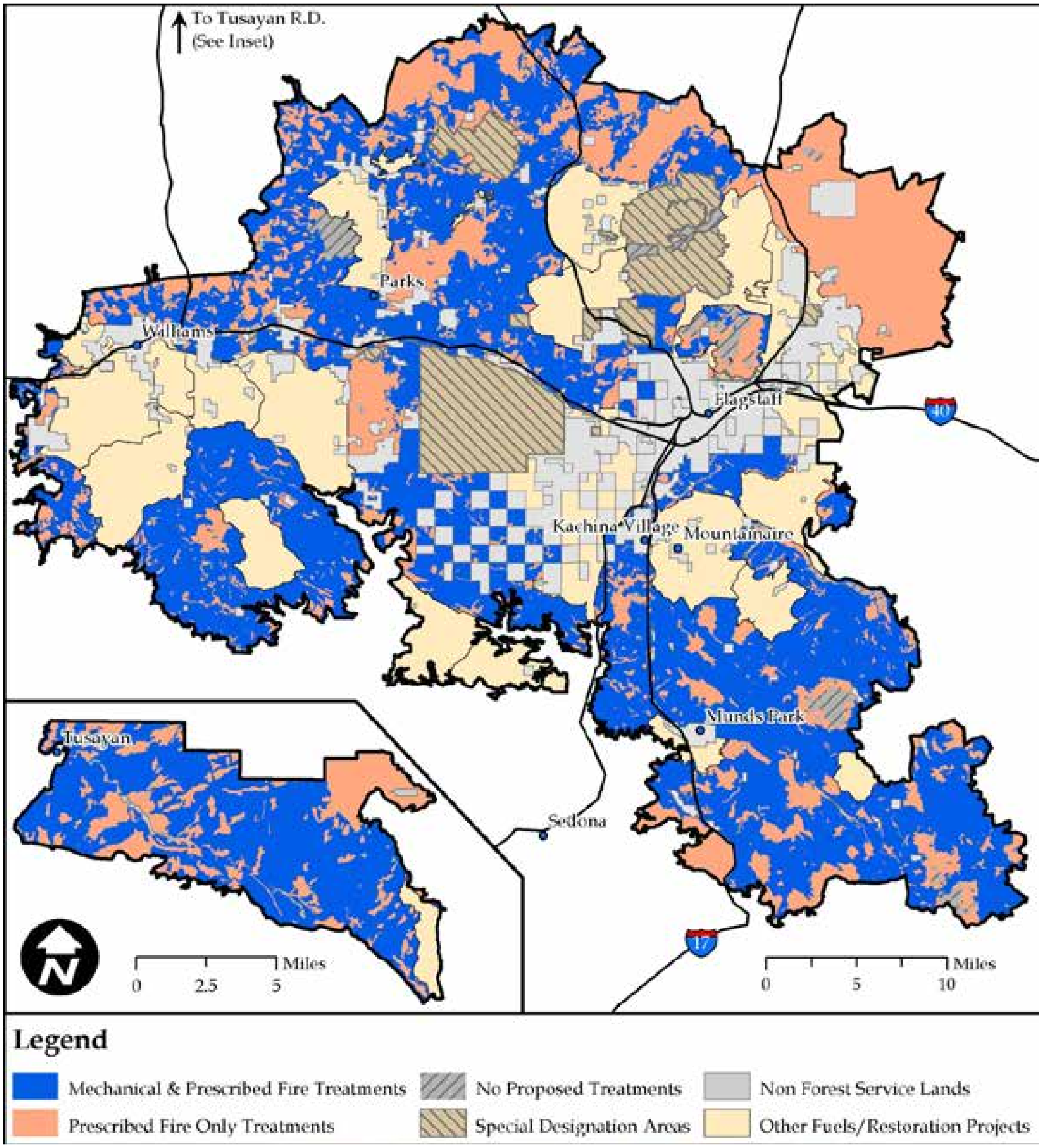


Figure 26. Alternative B general locations of mechanical and prescribed fire treatments

Table 18. Alternative B through D road activity miles by restoration unit (RU)

RU	Decommission		Temporary Road Construction and Decommission	Reconstruction –Relocation	Reconstruction –Improvement[8]
	Closed Roads	Unauthorized Roads	Temporary Roads		
1	205	0	110	2.2	8
3	100	77	166	2.8	9
4	185	33	198	1.1	9
5	280	0	27	0	3
6	0	24	15	3.3	1
Total	**770**	**134**	**517**	**10**	**30**

*Temporary roads that are constructed would be decommissioned once implementation is complete. Gates or other devices would be used as needed to manage motorized access during implementation.

Table 19. Alternative B through D springs, riparian, ephemeral streams, and aspen activities by restoration unit (RU)

RU	Springs Restoration (Number)	Riparian Habitat and Ephemeral Stream Restoration (Miles)	Aspen Restoration Mechanical Treatment (Acres)	Aspen Restoration Prescribed Fire (Acres)	Aspen Restoration Protective Fencing* (Miles)
1	32	24	182	167	11
3	24	7	201	0	17
4	14	5	453	46	41
5	4	2	392	10	14
6	0	<1	0	0	0
Total	**74**	**39**	**1,229**	**223**	**82**

*See appendix D for details on aspen treatment design.

[8] Road reconstruction improvements are estimated miles for the restoration units.

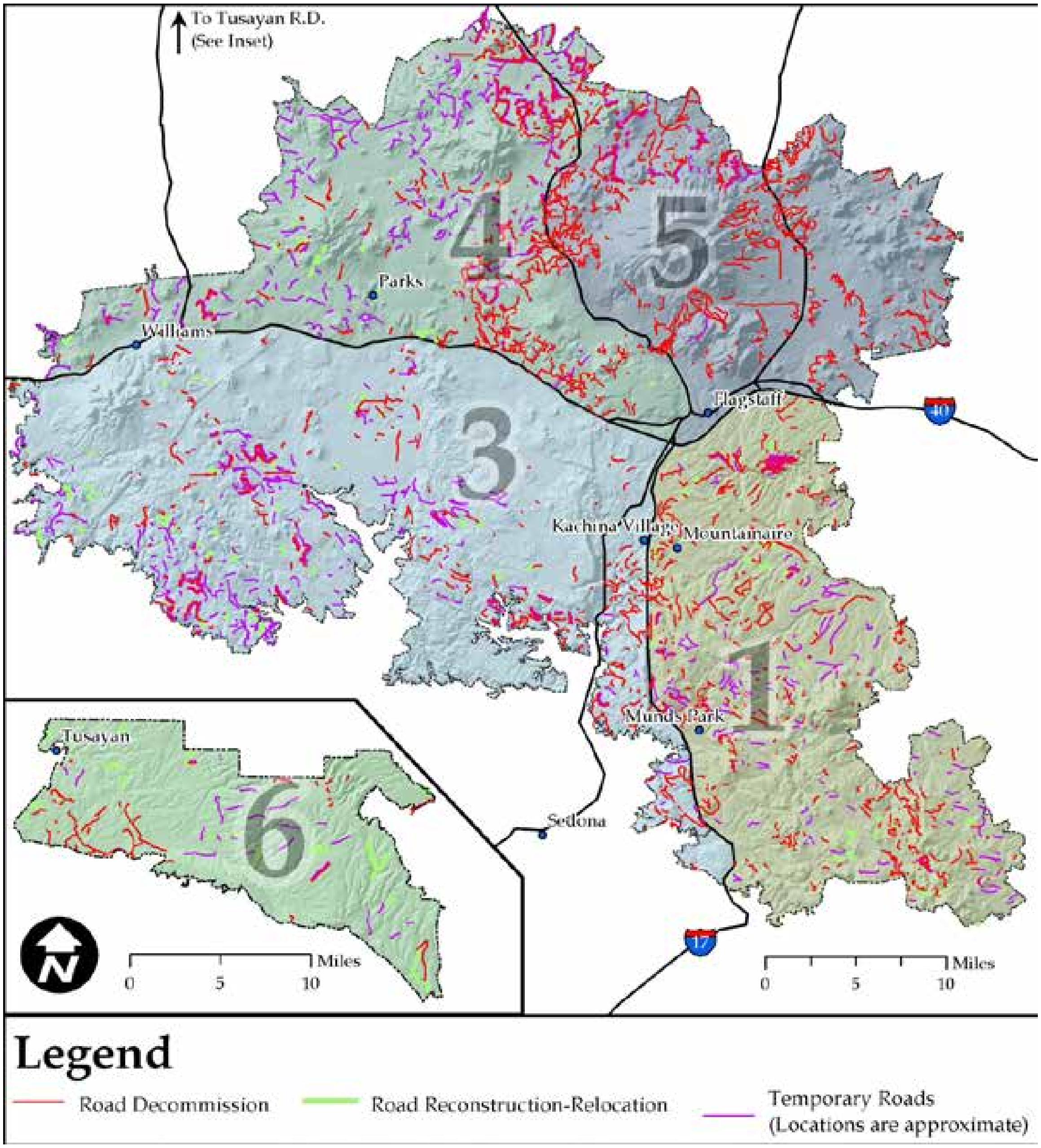


Figure 27. Alternative B–D general locations of road treatments

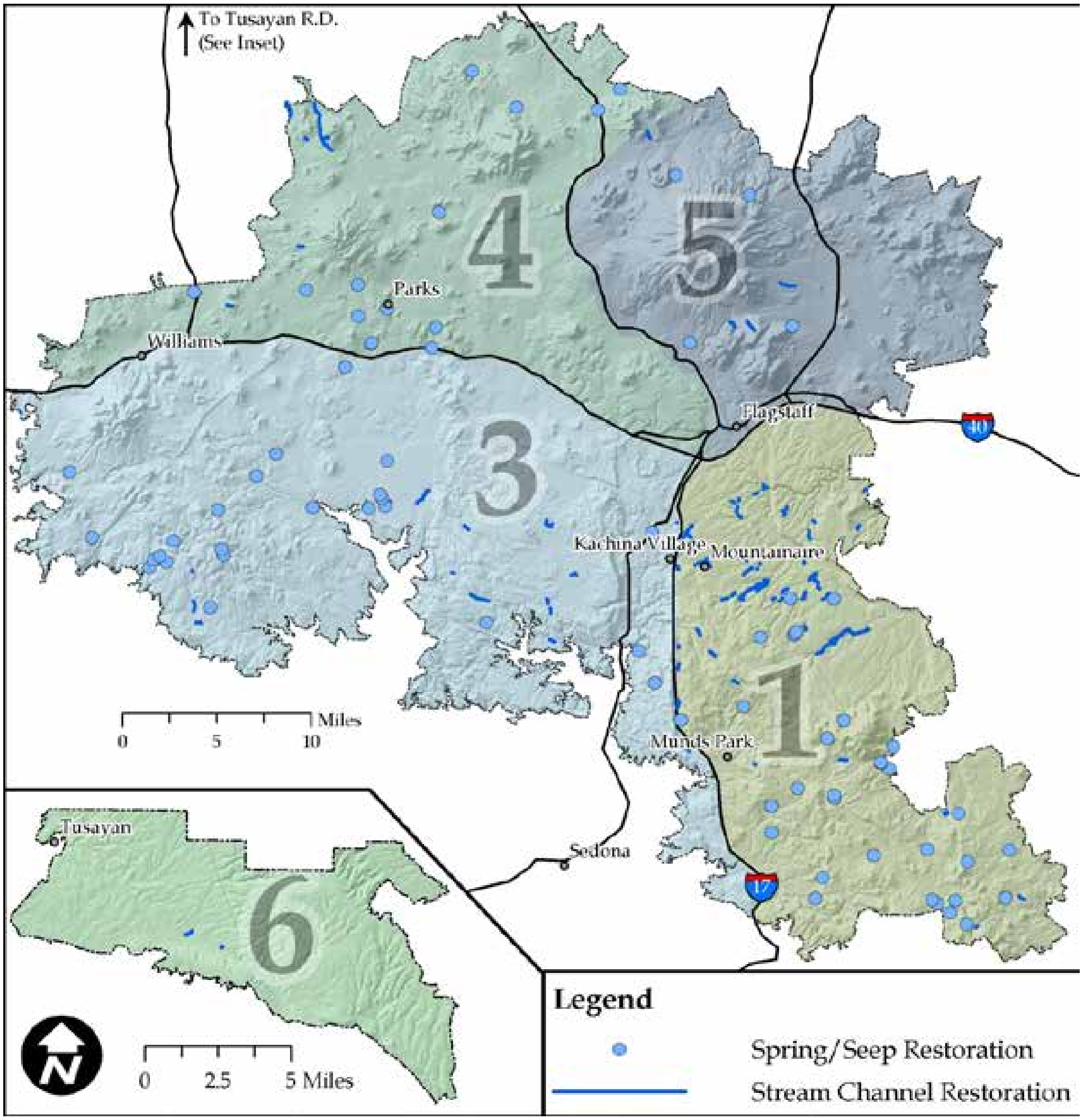


Figure 28. Alternative B–D general locations of spring and stream treatments

Table 20. Alternative B treatments in goshawk habitat

Treatment Type	Landscapes Outside of PFA (Acres)	Post-Fledgling Family Area (PFA) (Acres)	Dispersal Post-Fledgling Family Area (dPFA) (Acres)	Total Acres by Treatment Type
Uneven-aged (UEA)*	146,674	9,639	4,446	160,760
Intermediate Thinning (IT)	53,997	3,807	1,022	58,825
Stand Improvement (SI)	19,980	991	76	21,047
Savanna	45,469	0	0	45,469
Grassland	11,185	0	0	11,185
Pine-Sage	4,674	392	196	5,261
Prescribed Fire Only	86,933	8,733	1,299	96,965
Total mechanical treatment acres	281,979	14,828	5,740	302,548
Total prescribed fire treatment areas	368,912	23,561	7,039	399,512

*See appendix C and D for details on design features and mitigation for treatments within goshawk habitat.

Table 21. Alternative B summary of treatments in Mexican spotted owl (MSO) habitat

Treatment Type*	Protected (Acres)	Restricted (Acres)	Target and Threshold (Acres)	Total Acres by Treatment Type
Prescribed Fire Only	20,864	2,354	301	23,519
MSO Restricted	0	65,024	0	65,024
MSO Target	0	0	6,518	6,518
MSO Threshold	0	0	1,894	1,894
PAC -Mechanical	10,741	0	0	10,741
Total	**31,605**	**67,378**	**8,713**	**107,696**

* See appendix C and D for details on design features and mitigation for treatments within MSO habitat.

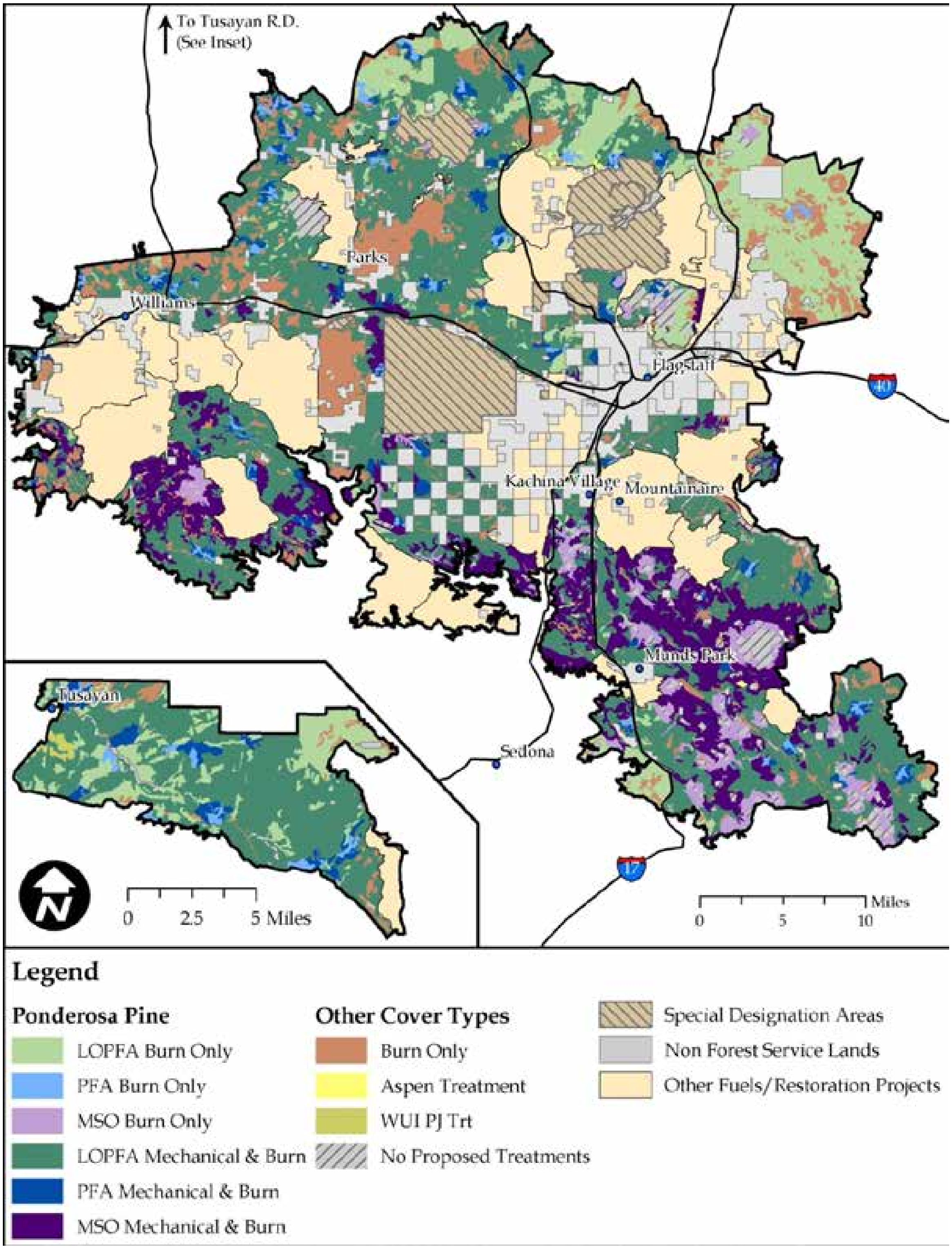


Figure 29. Alternative B mechanical and prescribed fire treatments in goshawk and MSO habitat

*LOPFA – Landscapes outside of PFAs.

Table 22. Alternative B–D ponderosa pine old growth allocation acres and percent by forest and restoration unit

Restoration Unit	Ponderosa Pine Total Acres		Ponderosa Pine Old Growth Acres		Old Growth Percent	
	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF
1	145,793	NA	65,189	NA	45	NA
3	58,327	70,898	21,341	25,177	37	36
4	56,981	77,320	17,718	30,342	31	39
5	61,671	NA	24,745	NA	40	NA
6	NA	41,188	NA	10,291	NA	25
Total	**322,772**	**189,407**	**128,994**	**65,810**	**40**	**35**

Table 23. Alternative B–D pinyon-juniper old growth allocation acres and percent by forest and restoration unit

Restoration Unit	Pinyon-Juniper Total Acres		Pinyon-Juniper Old Growth Acres		Pinyon-Juniper Old Growth Percent	
	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF	Coconino NF	Kaibab NF
1	1,141	NA	611	NA	54	NA
3	832	3,201	356	1,747	43	55
4	42	7,123	42	4,116	100	58
5	8,771	NA	7,302	NA	83	NA
6	NA	2,206	NA	1,452	NA	66
Total	**10,786**	**12,530**	**8,311**	**7,315**	**77**	**58**

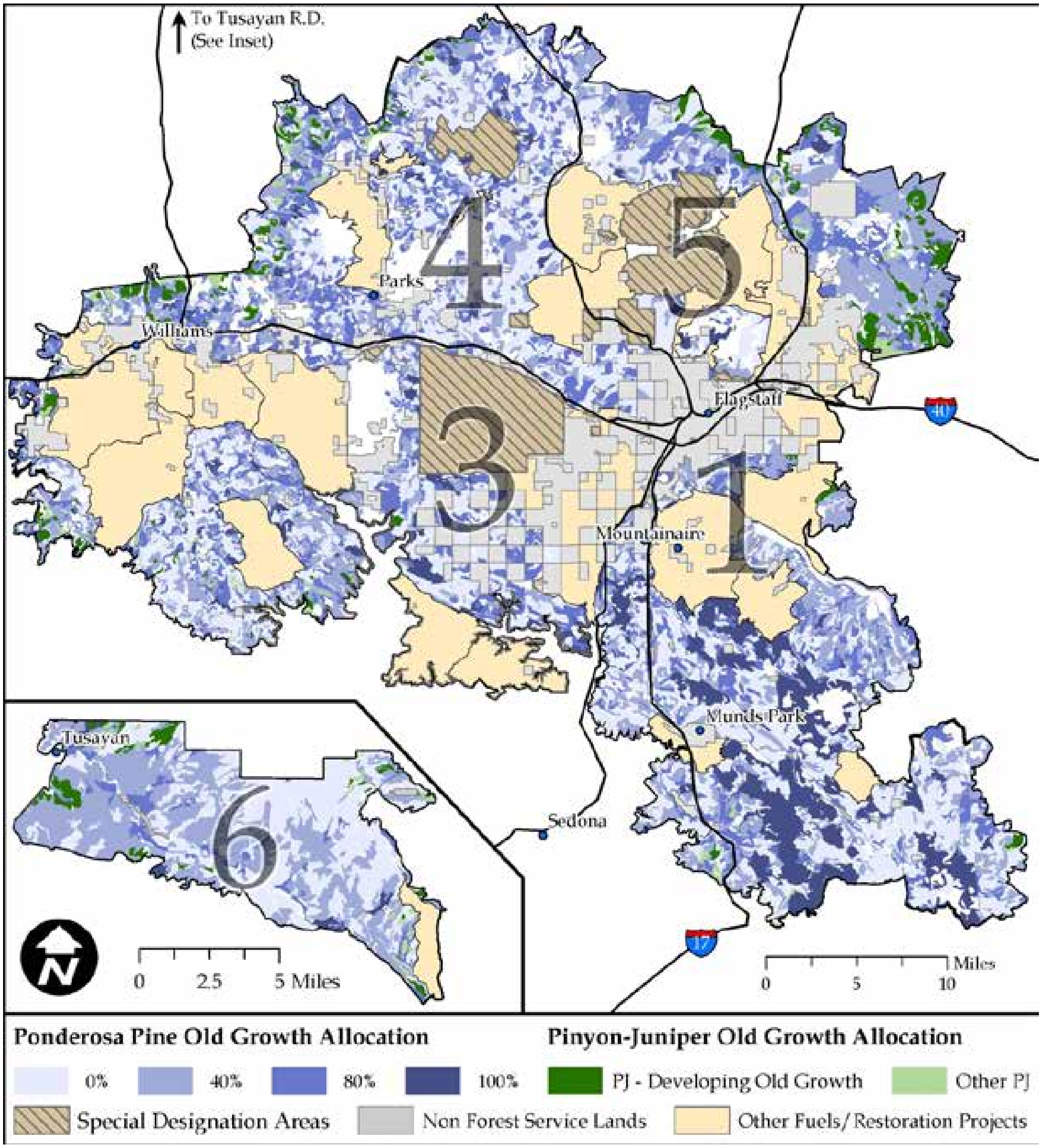


Figure 30. Alternative B–D ponderosa pine and pinyon-juniper old growth allocation

Alternative C (Preferred Alternative)

The Coconino and Kaibab NFs would conduct restoration activities on approximately 593,211 acres over a period of 10 years or until objectives are met. Up to 45,000 acres of vegetation would be mechanically treated annually. Up to 40,000 acres of prescribed fire would be implemented annually across the forests. Two prescribed fires[9] would be conducted on all acres proposed for treatment over the 10-year period. Restoration activities would:

- Mechanically cut trees on approximately 434,001 acres. This includes: (1) mechanically treating up to 18-inch d.b.h. within 18 Mexican spotted owl protected activity centers, (2) cutting trees by hand on 99 acres on slopes greater than 40 percent, and (3) using low-severity prescribed fire within 72 Mexican spotted owl protected activity areas (including 56 core areas).
- Utilize prescribed fire only on approximately 159,211 acres.
- Construct 517 miles of temporary roads for haul access and decommission when treatments are complete (no new permanent roads would be constructed).
- Reconstruct up to 40 miles of existing, open roads for resource and safety concerns (no new permanent roads would be constructed). Of these miles, approximately 30 miles would be improved to allow for haul (primarily widening corners to improve turn radiuses) and about 10 miles of road would be relocated out of stream bottoms. Relocated roads would include rehabilitation of the moved road segment.
- Decommission 770 miles of existing system and unauthorized roads on the Coconino NF.
- Decommission 134 miles of unauthorized roads on the Kaibab NF.
- Restore 74 springs and construct up to 4 miles of protective fencing.
- Restore 39 miles of ephemeral channels.
- Construct up to 82 miles of protective (aspen) fencing.
- Construct up to 15 weirs and 20 weather stations (up to 3 total acres of disturbance) to support watershed research.
- Allocate as old growth 40 percent of ponderosa pine and 77 percent of pinyon-juniper woodland on the Coconino NF and 35 percent of ponderosa pine and 58 percent of pinyon-juniper woodland on the Kaibab NF.

Three nonsignificant forest plan amendments (see appendix B) would be required on the Coconino NF to implement alternative C:

> **Amendment 1** would allow mechanical treatments up to 18-inch d.b.h. to improve habitat structure (nesting and roosting habitat) in 18 MSO PACs. It would allow low-intensity prescribed fire within 56 MSO PAC core areas. The amendment would remove language that limits PAC treatments in the recovery unit to 10 percent increments and language that requires the selection of an equal number of untreated PACs as controls. The amendment would remove language referencing monitoring (pre- and post-treatment, population, and habitat). Replacement language would defer final project design and monitoring to the FWS biological opinion specific to MSO for the project.
>
> The amendment, which is specific to restricted habitat in pine-oak, would allow for designating less than 10 percent of restricted habitat on the Coconino NF as target or

[9] The first prescribed fire may include pile burning followed by a broadcast burn.

threshold (i.e., future nesting and roosting habitat) based on the quality of the habitat. Definitions of target and threshold habitat would be added. It would allow 6,321 acres of restricted target and threshold habitat to be managed for a minimum range of 110 to 150 basal area.

Amendment 2 would add the desired percentage of interspace within uneven-aged stands to facilitate restoration in goshawk habitat (excluding nest areas), add the interspace distance between tree groups, add language clarifying where canopy cover is and is not measured, allow 29,017 acres to be managed for an open reference condition, and add a definition to the forest plan glossary for the terms interspaces, open reference condition, and stands.

Amendment 3 would remove the cultural resource standard that requires achieving a “no effect” determination and would add the words “or no adverse effect” to the remaining standard. In effect, management would strive to achieve a “no effect” or “no adverse effect” determination.

Three nonsignificant forest plan amendments (see appendix B) would be required on the Kaibab NF to implement alternative C:

Amendment 1 would add the desired percentage of interspace within uneven-aged stands to facilitate restoration in goshawk habitat (excluding nest areas), add the interspace distance between tree groups, add language clarifying where canopy cover is and is not measured, allow 27,675 acres to be managed for an open reference condition, and add a definition to the forest plan glossary for the terms interspaces, open reference condition, and stands.

Amendment 2 would allow for mechanically treating and using prescribed fire within approximately 400 acres of the proposed Garland Prairie Research Natural Area.

Amendment 3 would remove language that limits PAC treatments in the recovery unit to 10 percent increments and language that requires the selection of an equal number of untreated PACs as controls. The amendment would remove language referencing monitoring (pre- and post-treatment, population, and habitat). Replacement language would defer final project design and monitoring to the FWS biological opinion specific to MSO for the project.

The amendment, which is specific to restricted habitat in pine-oak, would allow for designating less than 10 percent of restricted habitat on the Kaibab NF as target or threshold (i.e., future nesting and roosting habitat) based on the quality of the habitat. Definitions of target and threshold habitat would be added. In restricted pine-oak habitat, it would allow 2,090 acres of restricted target and threshold habitat to be managed for a minimum range of 110 to 150 basal area.

Alternative C Tables and Figures

Table 24 describes mechanical and prescribed fire treatments and provides treatment acres. Figure 31 displays the general locations of mechanical and prescribed fire treatments.

Proposed roads, springs, ephemeral channels, and aspen treatments are the same as described in alternative B (see table 18 and table 19, and figure 27 and figure 28).

Table 25 and table 26 provide treatment type and acres in goshawk and MSO habitat. Figure 32 displays the general treatment locations in goshawk and MSO habitat.

Table 22 and table 23 display the old growth allocation acres by forest, restoration unit, and vegetation type. Figure 30 displays the general location of the old growth allocation.

The map packet in Appendix A provides all treatment maps at a larger scale for easier viewing

Table 24. Alternative C mechanical and prescribed fire treatment descriptions and acres

Treatment Type	Treatment Description/Objective	Acres
Aspen	Mechanical treatment that removes post-settlement conifers within 100 feet of aspen clone; stimulates suckering. Accompanied by prescribed fire.	1,229
Prescribed Fire Only	Prescribed fire would be applied exclusively to move treated areas toward desired vegetation conditions.	159,211
Arizona Game and Fish Research	Mechanical treatment designed to create groups of various sizes ranging from 1 to 15 acres in size. Accompanied by prescribed fire.	4,837
Grassland Restoration	Mechanical treatment that removes encroaching post-settlement conifers and manages for up to 90 percent of the treatment area as grass/forb/shrub using pre-settlement tree evidence as guidance. Accompanied by prescribed fire.	11,230
Grassland Mechanical	Mechanical treatment in grassland vegetation types. Accompanied by prescribed fire.	48,161
Intermediate Thin (IT) 10 (10 to 25% interspace)	Mechanical treatment that thins tree groups and establishes interspace adjacent to tree groups to an average of 70–90 square feet of basal area and manages for improved tree vigor and growth by retaining the best growing dominant and codominant trees with the least amount of mistletoe; interspace would occupy 10–55 percent of the treatment area, respectively. Accompanied by prescribed fire.	7,766
Intermediate Thin (IT) 25 (25 to 40% interspace)		11,858
Intermediate Thin (IT) 40 (40 to 55% interspace)		39,039
MSO Threshold	Same as MSO Target	1,894
MSO Target	Intermediate thinning (IT) designed to improve forest health, reduce fire risk, and meet forest density, structure, and species composition requirements. Accompanied by prescribed fire.	6,516
MSO Restricted	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure, irregular tree spacing, a mosaic of interspaces, and tree groups of varying sizes. Accompanied by prescribed fire.	63,191
MSO PAC	Mechanical treatment designed to increase tree vigor and health and create canopy gaps to reduce fire risk. Accompanied by prescribed fire.	10,741
MSO PAC Grassland Mechanical	Mechanical treatment designed to reestablish the historic meadow edge as defined by the current forest structure of young trees encroaching around the meadow edge; retain large trees with long-lived characteristics. Accompanied by prescribed fire.	35

Treatment Type	Treatment Description/Objective	Acres
Pine-Sage	Mechanical treatment that restores pre-settlement tree density and pattern using pre-settlement tree evidence as guidance. Accompanied by prescribed fire.	5,261
Savanna (70 to 90% interspace)	Mechanical treatment that restores pre-settlement tree density and pattern, and manages for a range of 70–90 percent of the treatment area as interspace (grass/forb) between tree groups or individual trees using pre-settlement tree evidence as guidance. Treatment would be accompanied by prescribed fire.	45,462
Stand Improvement (SI) 10 (10 to 25% interspace)	Mechanical treatment that establishes tree groups and interspace adjacent to tree groups and manages for improved tree vigor and growth by retaining the best growing dominant and codominant trees within each group; interspace would occupy 10–55 percent of the treatment area, respectively. Treatments would be accompanied by prescribed fire.	1,914
Stand Improvement (SI) 25 (25 to 40% interspace)		6,824
Stand Improvement (SI) 40 (40 to 55% interspace)		12,244
Uneven-aged (UEA) 10 (10 to 25% interspace)	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure and a mosaic of interspaces and tree groups of varying sizes. Interspace would occupy 10–25 percent of the treatment area. Accompanied by prescribed fire.	18,109
Uneven-aged (UEA) 25 (25 to 40% interspace)	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure and a mosaic of interspaces and tree groups of varying sizes. Interspace would occupy 25–40 percent of the treatment area. Accompanied by prescribed fire.	39,176
Uneven-aged (UEA) 40 (40 to 55% interspace)	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure and a mosaic of interspaces and tree groups of varying sizes. Interspace would occupy 40–55 percent of the treatment area. Accompanied by prescribed fire.	95,712
Wildland-Urban Interface (WUI) Pinyon-Juniper	Mechanical treatment around the community of Tusayan designed to reduce fire risk and meet community wildfire protection plan (CWPP) objectives. Accompanied by prescribed fire.	535
Wildland-Urban Interface (WUI) (55 to 70% interspace)	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure and a mosaic of interspaces and tree groups of varying sizes. Interspace would occupy 55–70 percent of the treatment area. Accompanied by prescribed fire.	2,268

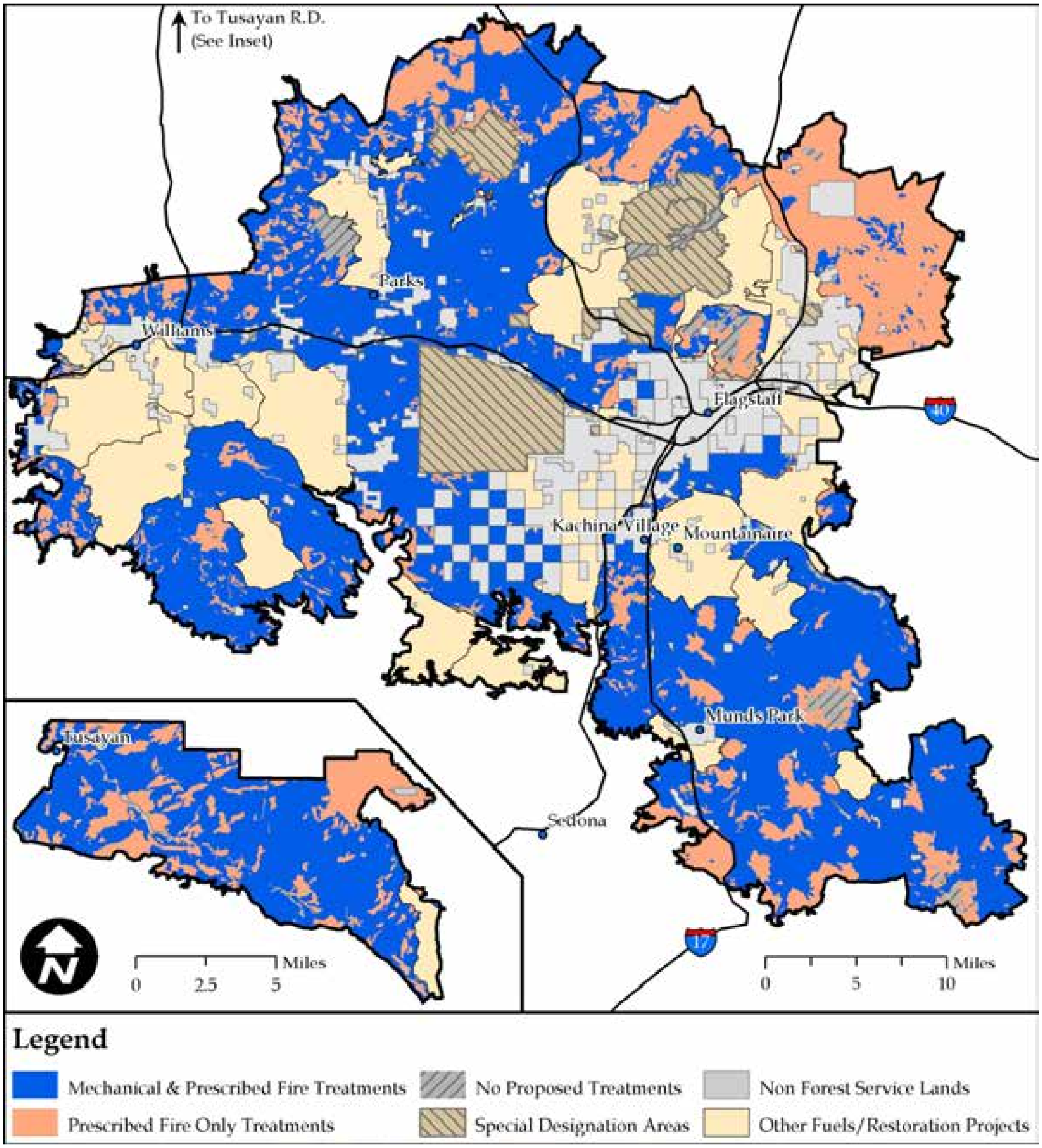


Figure 31. Alternative C mechanical and prescribed fire treatments

Table 25. Alternative C treatments in goshawk habitat

Vegetation Treatment Type	Landscapes Outside of PFA (Acres)	Post-Fledgling Family Area (PFA) (Acres)	Dispersal Post-Fledgling Family Area (dPFA) (Acres)	Total Acres by Treatment Type
Uneven-aged (UEA)*	146,040	9,616	4,446	160,102
Intermediate Thinning (IT)	53,834	3,807	1,022	58,662
Stand Improvement (SI)	19,915	991	76	20,982
Savanna	45,462	0	0	45,462
Grassland restoration within ponderosa pine	11,230	0	0	11,230
Pine-Sage	4,674	392	196	5,261
Prescribed Fire Only	87,879	8,755	1,299	97,934
Total mechanical treatment acres	281,154	14,805	5,740	301,699
Total prescribed fire treatment areas	369,033	23,561	7,039	399,633

*See appendix C and D for details on how treatments would be designed within goshawk habitat.

Table 26. Alternative C Treatments in Mexican spotted owl (MSO) Habitat

Treatment Type*	Protected Habitat (Acres)	Restricted Habitat (Acres)	Target/Threshold Habitat (Acres)	Total Treatment Acres
Prescribed Fire Only	25,714	4,187	303	30,204
MSO Restricted	0	63,191	0	63,191
MSO Target	0	0	6,516	6,516
MSO Threshold	0	0	1,894	1,894
PAC Mechanical	10,741	0	0	10,741
Total	**36,455**	**67,378**	**8,713**	**112,546**

* See appendix C and D for details on how treatments would be designed within MSO habitat.

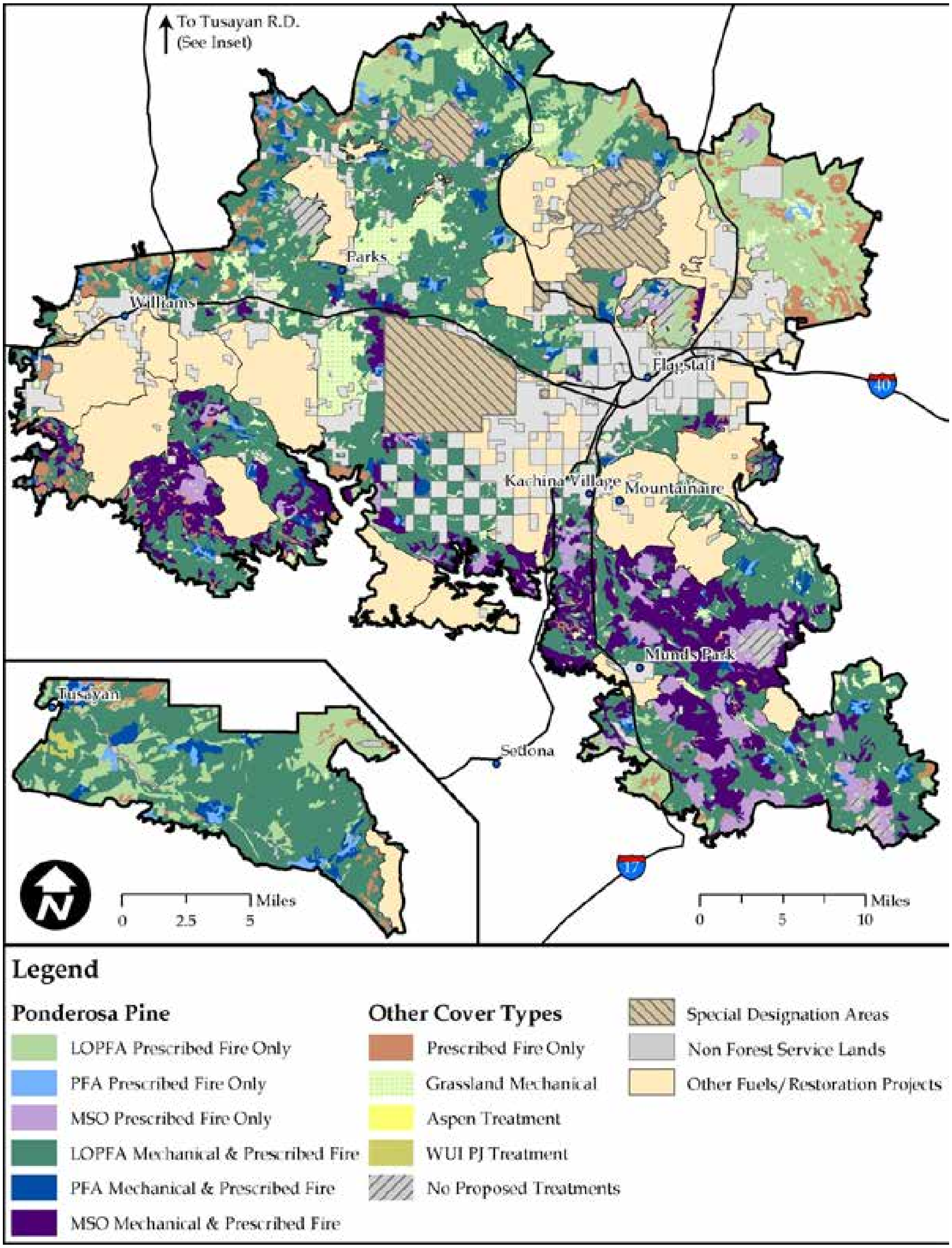


Figure 32. Alternative C mechanical and prescribed fire treatments in goshawk and MSO habitat

*LOPFA – landscapes outside of goshawk PFAs.

Alternative D

Alternative D responds to Issue 2 (prescribed fire emissions) by decreasing prescribed fire acres by 30 percent when compared to alternative B (proposed action). A select number of MSO PACs would be mechanically treated but would not be treated with prescribed fire. All other components of the alternative are the same as described in alternative B.

The Coconino and Kaibab NFs would conduct restoration activities on approximately 567,279 acres over a period of 10 years or until objectives are met. Up to 45,000 acres of vegetation would be mechanically treated annually. Restoration activities would:

- Mechanically cut trees on approximately 388,489 acres. This includes: (1) mechanically treating up to 16-inch d.b.h. within 18 Mexican spotted owl protected activity centers, (2) cutting 99 acres of trees by hand on slopes greater than 40 percent, and (3) disposing of slash through various methods including chipping, shredding, mastication, and removal of biomass offsite.
- Utilize prescribed fire only on approximately 178,790 acres. Up to 40,000 acres of prescribed fire would be implemented annually across the forests. Two prescribed fires would occur over the 10-year treatment period.
- Construct 517 miles of temporary roads for haul access and decommission when treatments are complete (no new permanent roads would be constructed).
- Reconstruct up to 40 miles of existing, open roads for resource and safety concerns (no new permanent roads would be constructed). Of these miles, approximately 30 miles would be improved to allow for haul (primarily widening corners to improve turn radiuses) and about 10 miles of road would be relocated out of stream bottoms. Relocated roads would include rehabilitation of the moved road segment.
- Decommission 770 miles of existing system and unauthorized roads on the Coconino NF.
- Decommission 134 miles of unauthorized roads on the Kaibab NF.
- Restore 74 springs and construct up to 4 miles of protective fencing.
- Restore 39 miles of ephemeral channels.
- Construct up to 82 miles of protective (aspen) fencing.
- Allocate as old growth 40 percent of ponderosa pine and 77 percent of pinyon-juniper woodland on the Coconino NF, and 35 percent of ponderosa pine and 58 percent of pinyon-juniper on the Kaibab NF.

Three nonsignificant forest plan amendments (see appendix B) would be required on the Coconino NF to implement alternative D:

Amendment 1 would add language to allow mechanical treatments up to 16-inch d.b.h. to improve habitat structure (nesting and roosting habitat) in 18 MSO PACs. The amendment would remove language that limits PAC treatments in the recovery unit to 10 percent increments and language that requires the selection of an equal number of untreated PACs as controls. The amendment would remove language referencing monitoring (pre- and post-treatment, population, and habitat). Replacement language would defer final project design and monitoring to the FWS biological opinion specific to MSO for the project.

The amendment, which is specific to restricted habitat in pine-oak, would allow for designating less than 10 percent of restricted habitat on the Coconino NF as target or threshold (i.e., future nesting and roosting habitat) based on the quality of the habitat. Definitions of target and threshold habitat would be added.

Amendment 2 would add the desired percentage of interspace within uneven-aged stands to facilitate restoration in goshawk habitat (excluding nest areas), add the interspace distance between tree groups, add language clarifying where canopy cover is and is not measured, allow 29,017 acres to be managed for an open reference condition, and add a definition to the forest plan glossary for the terms interspaces, open reference condition, and stands.

Amendment 3 would remove the cultural resource standard that requires achieving a “no effect” determination and would add the words “or no adverse effect” to the remaining standard. In effect, management would strive to achieve a “no effect” or “no adverse effect” determination.

Two nonsignificant forest plan amendments (see appendix B) would be required on the Kaibab NF to implement alternative D:

Amendment 1 would add the desired percentage of interspace within uneven-aged stands to facilitate restoration in goshawk habitat (excluding nest areas), add the interspace distance between tree groups, add language clarifying where canopy cover is and is not measured, allow 27,637 acres to be managed for an open reference condition, and add a definition to the forest plan glossary for the terms interspaces, open reference condition, and stands.

Amendment 2 would allow for designating less than 10 percent of restricted habitat in pine-oak as target or threshold (i.e., future nesting and roosting habitat) based on the quality of the habitat. The amendment would remove language that limits PAC treatments in the recovery unit to 10 percent increments and requires the selection of an equal number of untreated PACs as controls. The amendment would also remove language that references monitoring (pre- and post-treatment, population, and habitat). Replacement language would defer final project design and monitoring to the FWS biological opinion specific to MSO for the project.

Alternative D Tables and Figures

Table 17 describes treatments and provides treatment acres. Figure 33 displays the general locations of mechanical and prescribed fire treatments.

Table 18 (see alternative B) provides acres by road treatment type and restoration unit. Figure 27 displays the general locations of road treatments.

Table 19 (see alternative B) provides acres of springs, channels, and aspen treatments by restoration unit. Figure 28 displays the general locations for these treatments.

Table 22 and table 23 (see alternative B) display the old growth allocation acres by forest, restoration unit, and vegetation type. Figure 30 displays the general location of the old growth allocation.

Table 28 and table 29 provide treatment type and acres in goshawk and MSO habitat. Figure 34 displays the general treatment locations.

The map packet in appendix A provides treatment maps at a larger scale for easier viewing.

Table 27. Alternative D mechanical and prescribed fire treatment descriptions and acres

Treatment Type	Treatment Description/Objective	Acres
Aspen	Mechanical treatment that removes post-settlement conifers within 100 feet of aspen clone; stimulates suckering.	1,229
Prescribed Fire Only	Prescribed fire would be applied exclusively to move treated areas toward desired vegetation conditions.	178,790
Grassland Restoration	Mechanical treatment that remove encroaching post-settlement conifers and manages for up to 90 percent of the treatment area as grass/forb/shrub using pre-settlement tree evidence as guidance.	11,185
Intermediate Thin (IT) 10 (10 to 25% interspace)	Mechanical treatment that thins tree groups and establishes interspace adjacent to tree groups to an average of 70–90 square feet of basal area and manages for improved tree vigor and growth by retaining the best growing dominant and codominant trees with the least amount of mistletoe; interspace would occupy 10–55 percent of the treatment area, respectively.	7,766
Intermediate Thin (IT) 25 (25 to 40% interspace)		11,871
Intermediate Thin (IT) 40 (40 to 55% interspace)		39,189
MSO Threshold	Same as MSO Target	1,894
MSO Target	Intermediate thinning (IT) designed to improve forest health, reduce fire risk, and meet forest density, structure, and species composition requirements.	6,518
MSO Restricted	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure, irregular tree spacing, a mosaic of interspaces, and tree groups of varying sizes.	65,024
MSO PAC	Mechanical treatment designed to increase tree vigor and health and create canopy gaps to reduce fire risk.	10,741
Pine-Sage	Mechanical treatment that restores pre-settlement tree density and pattern using pre-settlement tree evidence as guidance.	5,261
Savanna (70 to 90% interspace)	Mechanical treatment that restores pre-settlement tree density and pattern and manages for a range of 70–90 percent of the treatment area as interspace (grass/forb) between tree groups or individual trees using pre-settlement tree evidence as guidance.	45,469
Stand Improvement (SI) 10 (10 to 25% interspace)	Mechanical treatment that establishes tree groups and interspace adjacent to tree groups and manages for improved tree vigor and growth by retaining the best growing dominant and codominant trees within each group; interspace would occupy 10–55 percent of the treatment area, respectively.	1,914
Stand Improvement (SI) 25 (25 to 40% interspace)		6,824
Stand Improvement (SI) 40 (40 to 55% interspace)		12,309
Uneven-aged (UEA) 10 (10 to 25% interspace)	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure and a mosaic of interspaces and tree groups of varying sizes. Interspace would occupy 10–25 percent of the	18,204

Treatment Type	Treatment Description/Objective	Acres
	treatment area.	
Uneven-aged (UEA) 25 (25 to 40% interspace)	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure and a mosaic of interspaces and tree groups of varying sizes. Interspace would occupy 25–40 percent of the treatment area.	39,244
Uneven-aged (UEA) 40 (40 to 55% interspace)	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure and a mosaic of interspaces and tree groups of varying sizes. Interspace would occupy 40–55 percent of the treatment area.	101,044
Wildland-Urban Interface (WUI) Pinyon-Juniper	Mechanical treatment around the community of Tusayan designed to reduce fire risk and meet community wildfire protection plan (CWPP) objectives.	535
Wildland-Urban Interface (WUI) (55 to 70% interspace)	Uneven-aged (UEA) mechanical treatment designed to develop uneven-aged structure and a mosaic of interspaces and tree groups of varying sizes. Interspace would occupy 55–70 percent of the treatment area.	2,268

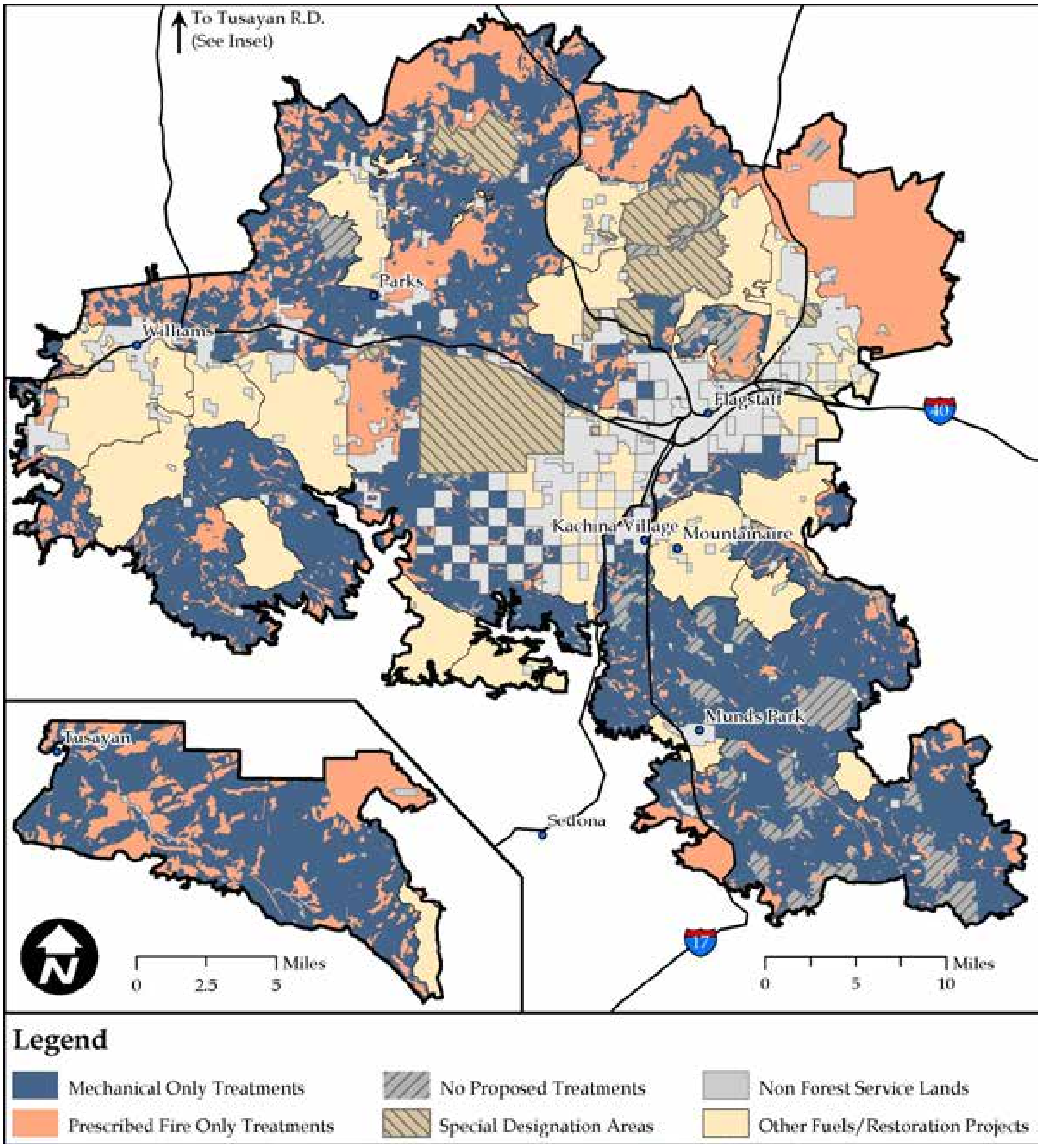


Figure 33. Alternative D mechanical and prescribed fire treatments

Table 28. Alternative D treatments in goshawk habitat

Vegetation Treatment Type	Landscapes Outside of PFA (Acres)	Post-Fledgling Family Area (PFA) (Acres)	Dispersal Post-Fledgling Family Area (dPFA) (Acres)	Total Acres by Treatment Type
Uneven-aged (UEA)*	146,674	9,639	4,446	160,760
Intermediate Thinning (IT)	53,997	3,807	1,022	58,825
Stand Improvement (SI)	19,980	991	76	21,047
Savanna	45,469	0	0	45,469
Grassland Restoration	11,185	0	0	11,185
Pine-Sage	4,674	392	196	5,261
Prescribed Fire Only	86,933	8,733	1,299	96,965
Total Mechanical Treatment Acres	281,979	14,828	5,740	302,548
Total Prescribed Fire Treatment Areas	86,933	8,733	1,299	96,965

*See appendix C and D for details on how treatments would be designed within goshawk habitat.

Table 29. Alternative D treatments in MSO habitat

Treatment Type*	Protected Habitat (Acres)	Restricted Habitat (Acres)	Target and Threshold Habitat (Acres)	Total Treatment Acres
Prescribed Fire Only	889	2,354	301	3,543
MSO Restricted	0	65,024	0	65,024
MSO Target	0	0	6,518	6,518
MSO Threshold	0	0	1,894	1,894
PAC - Mechanical	10,741	0	0	10,741
Total	**11,630**	**67,378**	**8,713**	**87,721**

* See appendix C and D for details on how treatments would be designed within MSO habitat.

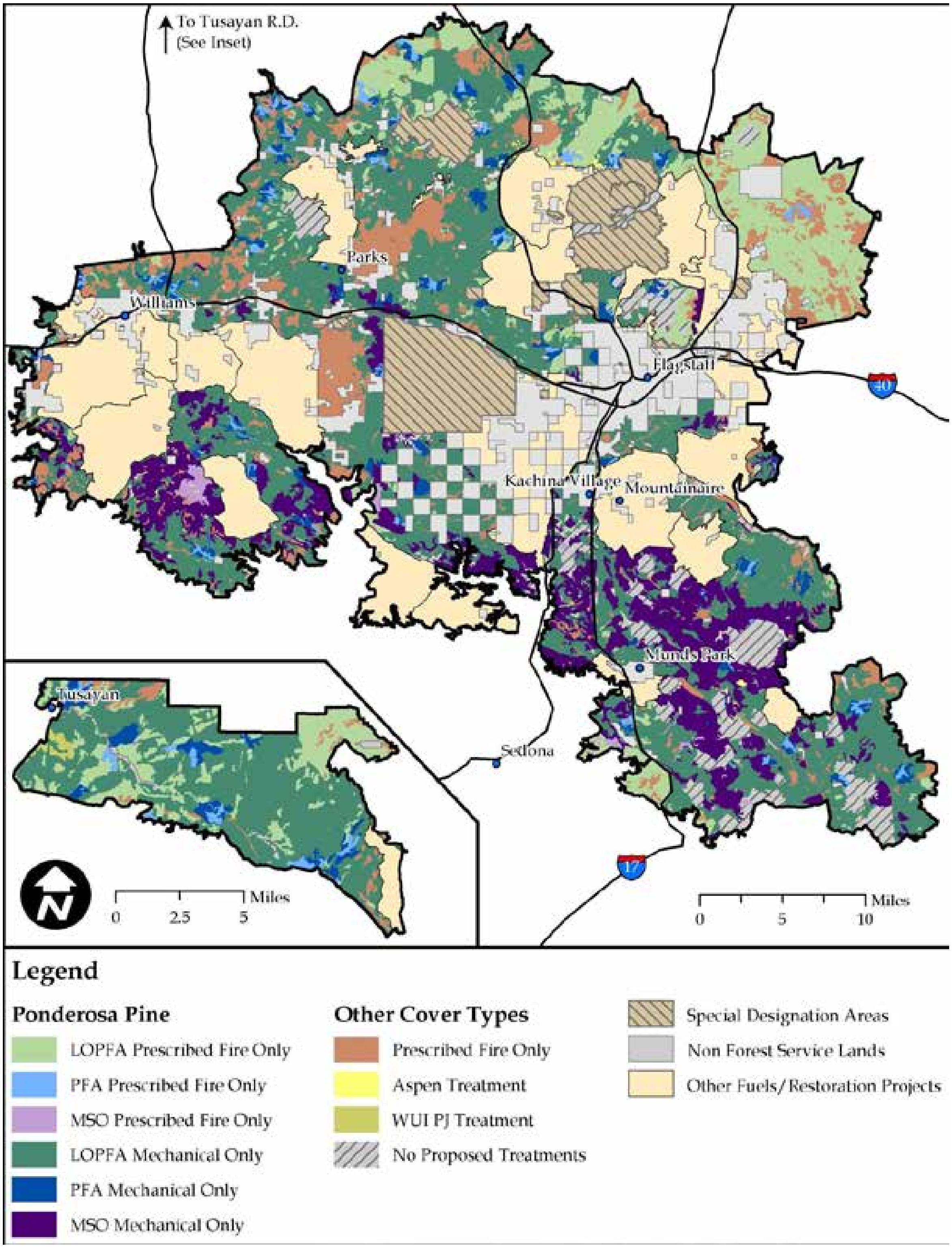


Figure 34. Alternative D mechanical and prescribed fire treatments in goshawk and MSO habitat

*LOPFA – landscapes outside of goshawk PFAs.

Comparison of Alternatives

Table 30 provides a summary of the alternatives and table 31 describes potential effects of implementing each alternative considered in detail. Information in this table focuses on effects related to the purpose and need for the project. See chapter 3 for detailed discussion of the effects and the specialists' reports for the complete analysis.

Table 30. Summary of alternatives analyzed in detail

Proposed Activity	Alt. A (No Action)	Alt. B (Proposed Action)	Alt. C	Alt. D
Vegetation Mechanical Treatment (acres)	0	388,489	434,001	388,489
Prescribed Fire (acres)	0	587,923	593,211	178,790
Mexican Spotted Owl (MSO) Protected Activity Centers (PACs) Habitat Treatments	NA	Mechanically treat up to 16-inch d.b.h. in 18 PACs (excluding core areas). Utilize prescribed fire in 72 MSO PACs (excluding core areas).	Mechanically treat up to 18-inch d.b.h. in 18 PACs. Utilize prescribed fire in 56 MSO PACs (including core areas). Utilize prescribed fire in 16 MSO PACs (excluding core areas).	Mechanically treat up to 16-inch d.b.h. in 18 PACs (excluding core areas). Utilize prescribed fire in 72 MSO PACs (excluding core areas).
Springs Restored (number)	0	74	Same as alternative B	
Springs Protective Fence Construction (miles)	0	Up to 4	Same as alternative B	
Aspen Protective Fencing (miles)		Up to 82	Same as alternative B	
Ephemeral Stream Restoration (miles)	0	39	Same as alternative B	
Temporary Road Construction and Decommission (miles)	0	517	Same as alternative B	
Road Reconstruction-Improvement (miles)	NA	Up to 30	Same as alternative B	
Road Relocation (miles)	NA	Up to 10	Same as alternative B	
Existing Road Decommission (miles)	NA	770	Same as alternative B	
Unauthorized Route Decommission (miles)	NA	134	Same as alternative B	

Table 31. Comparison of alternatives

<table>
<tr><th>Indicator</th><th>Existing Condition</th><th>Desired Condition</th><th>Alternative A</th><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="7">Vegetation Structure and Pattern</td></tr>
<tr><td rowspan="4">Age and Size Class</td><td>Even-aged: 46%</td><td rowspan="4">Move even-aged stands toward an uneven-aged structure.
There is a distribution of age-classes that comprise a sustainable balance of vegetation structural stages (VSS).</td><td>Alternative A does not meet the desired condition with even-aged stands remaining even aged.</td><td colspan="3">Alternatives B–D meet the desired condition with even-aged stands trending toward uneven-aged.</td></tr>
<tr><td>Uneven-aged: 54%</td><td>Alternative A does not meet the desired conditions with uneven-aged stands trending toward even aged.</td><td colspan="3">Alternatives B–D meet the desired condition with uneven-aged being maintained as uneven-aged.</td></tr>
<tr><td>Dominant representation is in the young (VSS 2) and mid-aged (VSS 3) structural stages</td><td colspan="4">In all alternatives (immediately post-treatment), the dominant representation is in the young and mid-aged structural stages.</td></tr>
<tr><td>Low representation in the grass/forb/ shrub, seedling/ sapling, mature and old structural stages.</td><td>Low representation in the grass/forb/shrub, seedling/sapling, mature and old structural stages.</td><td colspan="3">Alternatives B–D: Improved representation in the grass/forb/shrub, seedling/sapling, mature, and old structural stages. Trending toward a balance of structural stages.</td></tr>
</table>

<table>
<tr><th>Indicator</th><th>Existing Condition</th><th>Desired Condition</th><th>Alternative A</th><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td rowspan="5">Spatial Arrangement
Indicators:
High –Treatment acres with a high potential to attain desired conditions
Moderate – Treatment areas with moderate potential to attain desired conditions
Low to Very Low – Treatment acres with low or very low potential to attain desired conditions</td><td rowspan="5">Continuous tree canopy with generally small interspaces.</td><td rowspan="5">Mosaic of interspaces and tree groups of varying sizes and shapes.</td><td rowspan="5">Similar to existing. Trending toward a reduction of interspaces .</td><td colspan="3">Treatment acres (and percent) with relative ability to attain mosaic of interspaces and tree groups ranging from very low to high:</td></tr>
<tr><td>Very Low: 47,157 (9%)</td><td>Very Low: 52,007 (10%)</td><td>Very Low: 27,182 (6%)</td></tr>
<tr><td>Low: 120,363 (24%)</td><td>Low: 126,074 (25%)</td><td>Low: 120,327 (25%)</td></tr>
<tr><td>Moderate: 122,963 (24%)</td><td>Moderate: 121,050 (24%)</td><td>Moderate: 122,963 (25%)</td></tr>
<tr><td>High: 216,725 (43%)</td><td>High: 211,215 (41%)</td><td>High: 216,762 (44%)</td></tr>
<tr><td rowspan="6">Heterogeneity:
Percent of landscape openness within ponderosa pine ranging from very open to closed or unknown</td><td rowspan="6">Very Open: 22%
Open: 22%
Moderately Closed: 29%
Closed: 45%
Unknown: 3%</td><td rowspan="6">Ranges from very open to closed.
Desired openness is determined by soils and site potential.</td><td rowspan="6">Similar to existing condition, trending toward closed.</td><td colspan="3">Percent of openness ranging from very open to closed to unknown:</td></tr>
<tr><td>Very Open: 11</td><td>Very Open: 11</td><td>Very Open: 11</td></tr>
<tr><td>Open: 31</td><td>Open: 30</td><td>Open: 31</td></tr>
<tr><td>Moderately Closed: 42</td><td>Moderately Closed: 42</td><td>Moderately Closed: 42</td></tr>
<tr><td>Closed: 15</td><td>Closed: 17</td><td>Closed: 11</td></tr>
<tr><td>Unknown: 1</td><td>Unknown: 0</td><td>Unknown: 5</td></tr>
</table>

Indicator	Existing Condition	Desired Condition	Alternative A	Alternative B	Alternative C	Alternative D
Large/Old Tree Structure	VSS 5 and VSS 6 (large and old trees) are underrepresented across the landscape.	Uneven-aged and composed of a distribution of age classes that comprise a sustainable balance of structural stages. Manage for old age (pre-settlement) trees such that old forest structure is sustained over time across the landscape.	Over time, old growth conditions improve in terms of meeting the minimum criteria but the sustainability of large/old trees may be impaired by density-related mortality and forest health issues.	The MSO, goshawk, old growth, and forest health analysis indicates sustainability of the large/old tree component across the landscape would be improved.		
Forest Health						
Stand Density	Percent of maximum SDI by Habitat:	Density is below the zone where density-related mortality is prevalent (<56% of maximum SDI). Managed, uneven-aged forests range from 15–40% of maximum SDI.	**Percent of maximum SDI by habitat (the desired condition is to have <56 of maximum SDI—habitats meeting the desired condition is displayed in bold text):**			
	MSO Protected: 78		MSO Protected: 80	MSO Protected: 72	MSO Protected: 71	MSO Protected: 74
	MSO Target/Threshold: 85		MSO Target/Threshold: 86	MSO Target/Threshold: 75	MSO Target/Threshold: 71	MSO Target/Threshold: 76
	MSO Restricted: 69		MSO Restricted: 72	**MSO Restricted: 37**	**MSO Restricted: 37**	**MSO Restricted: 46**
	Goshawk Nest/PFA: 45		**Goshawk Nest/PFA: 47**	**Goshawk Nest/PFA: 27**	**Goshawk Nest/PFA: 27**	**Goshawk Nest/PFA: 30**
	Goshawk non PFA (LOPFA): 40		**Goshawk non PFA (LOPFA*): 43**	**Goshawk non PFA (LOPFA): 21**	**Goshawk non-PFA (LOPFA): 21**	**Goshawk non-PFA (LOPFA0: 24**

Indicator	Existing Condition	Desired Condition	Alternative A	Alternative B	Alternative C	Alternative D
Insect and Disease Beetle hazard rating (percent of landscape) ranging from low to extreme	Low: 8 Moderate: 21 High: 71	Forest conditions are resilient to insect and disease. Insect and disease populations are at endemic levels. Beetle hazard ratings range from low to moderate	**Beetle hazard rating (percent) (the desired condition is to have ratings range from low to moderate—conditions meeting the desired are displayed in bold text):**			
			Low: 4 **Moderate: 13** High: 83	**Low: 38** **Moderate: 36** High: 26	**Low: 38** **Moderate: 36** High: 26	**Low: 28** **Moderate: 26** High: 45
Dwarf mistletoe infection level ranging from none/low to extreme	None/Low: 66 Moderate/High: 34 Extreme: <1		**Dwarf mistletoe infection level (percent):**			
			None/Low: 59 Moderate/High:41 Extreme: <1	None/Low: 61 Moderate/High: 39 Extreme: <1	None/Low: 60 Moderate/High: 40 Extreme: <1	None/Low: 60 Moderate/High: 40 Extreme: <1
Vegetation Diversity and Composition						
Gambel oak	112,546 acres of pine-oak MSO habitat	Conserve oak and improve conditions that favor oak growth and establishment	**Treatment acres that would actively reduce pine-oak competition:**			
			0	65,024	63,191	65,024
			Treatment acres within pine-oak MSO habitat that would release large oak:			
			0	84,177	82,344	84,177
Aspen	1,471 acres of aspen patches (within pine)	Maintain and/or regenerate aspen patches	**Acres of aspen maintained and/or regenerated:**			
			0	1,452	1,471	1,452
Grasslands	48,196 acres of encroached grasslands (mollisol soils).	Restore grasslands. Enhance historic grassland inclusions within greater forested area including MSO restricted, goshawk PFA, and	**Acres of grassland enhanced and/or restored within: (1) encroached grasslands, (2) historic grasslands, (3) pine with an open reference condition, and (4) goshawk PFA, non-PFA, and MSO restricted habitat:**			
			0	(1) 0	(1) 48,196	0
			0	(2) 11,185	(2) 11,230	(2) Same as alt. B
	14,665 acres departed from		0	(3) 45,469	(3) Same as alternative B	

Indicator	Existing Condition	Desired Condition	Alternative A	Alternative B	Alternative C	Alternative D
	historic grassland conditions	non-PFA (LOPFA*) habitats.				
	309,926 acres of ponderosa pine with an open reference conditions (mollic-integrade soils).		0	(4)310,917	(4) 308,199	(4) 305,657
Pine-Sage	16,000 acres of pine-sage potential vegetation	Maintain and enhance the sage understory. Restore the historic overstory/ understory pattern within the pine-sage mosaic.	**Acres of pine-sage understory/overstory maintained and enhanced:**			
			0	Alternatives B, C, and D: 5,262 acres		
Landscape-scale forest resiliency and function in ponderosa pine			**Improved vegetation structure, forest health and vegetation diversity and composition (acres):**			
			0	501,208	510,346	487,233
Forest Resiliency and Sustainability – Fire Behavior						
Crown Fire	34%	Up to 10%	35% (2020)	5% (2020)	4% (2020)	7% (2020)
Surface fire	64% 2% (NA – not burnable)	90%	64% (2020) 1% NA – not burnable	94% (2020) 1% NA – not burnable	94% (2020) 2% NA – not burnable	92% (2020 1% NA – not burnable
Fire Regime Condition Class (FRCC)	14% FRCC 1 27% FRCC 2 59% FRCC 3	100% FRCC 1 0% FRCC 2 0% FRCC 3	11% FRCC 1 19% FRCC 2 70% FRCC 3	18% FRCC 1 78% FRCC 2 4% FRCC 3	19% FRCC 1 81% FRCC 2 0% FRCC 3	8% FRCC 1 82% FRCC 2 10% FRCC 3

Indicator	Existing Condition	Desired Condition	Alternative A	Alternative B	Alternative C	Alternative D
Landscape-Scale Forest Resiliency and Function	Alternative A: The combination of abundant and continuous canopy fuels, the lack of understory vegetation, and an already high and increasing surface fuel load would combine with high potential for high-severity fire, and maintain the area in a FRCC of 3 into the foreseeable future. There would be no movement toward resiliency and improved function. Alternatives B, C, and D move toward FRCC desired conditions in the short term (2020). Alternatives B, C, and D meet crown and surface fire desired conditions in the short term (2020). Movement toward the desired conditions in Alternatives B, C, and D equates to movement toward improved resiliency and function.					
Watershed Function						
Overall Watershed Condition (within the analysis area)	22% functioning properly, 46% functioning at risk, 32% impaired.	Moving toward or at functioning properly.	Having high percentages of functioning at risk and impaired watersheds continues.	**Alternatives B and C**: 23% of functioning at risk watersheds (i.e., nearly ¼ of the 58% that are currently functioning at risk would move toward functioning properly) and 42% of impaired watersheds would improve (i.e., 42% of the current 22% impaired would move toward functioning properly). Under alternative D, 18% of functioning at-risk watersheds (i.e., nearly 1/5th of the 58% that are currently functioning at risk would move toward functioning properly) and 34% of impaired watersheds (i.e., about a 1/3rd of the 22% that are currently impaired would move toward functioning properly) would improve. **Alternative D** would not improve overall watershed condition as extensively as alternatives B and C. Approximately 496 miles of road are decommissioned in functioning at-risk watersheds and 226 miles in impaired function watersheds. Stream channel treatments improve waterflow regime on 19 miles of functioning at risk and 9 miles in impaired watersheds.		
Ephemeral Channels	Reduced function in 39 miles of degraded channel.	Proper functioning condition.	Static to downward trend in function over time.	Alternatives B–D: Disturbance would range from 2 to 108 acres in subwatersheds (1% of treatment area). Potential short-term increases in sediment production that could adversely impact surface water quality and riparian conditions are minimized or mitigated.		
Springs	Reduced discharge in 74 springs.	Soil, water, and vegetation attributes are present and allow springs to be healthy and functioning at or near potential.	Static to downward trend in functional condition.	Alternatives B–D: A slight increase in groundwater recharge and spring discharge would be expected in years 1 to 3. Long-term hydrologic response would be dependent on the summed effect of the changes in evaporation, transpiration, soil moisture storage, snowpack accumulation and melt processes, and presence or absence of drought conditions.		

Indicator	Existing Condition	Desired Condition	Alternative A	Alternative B	Alternative C	Alternative D
Water Quantity	Water yield in ponderosa pine is likely reduced from historic conditions due to forest ingrowth and dense stand conditions resulting in increased yearlong evapotrans-piration rates.	Increased streamflow as measured at stream gages installed at locations downstream of proposed treatment area.	No change. There is the potential for increased storm water runoff and flooding downstream of areas burned in wildfires.	Water yield would be expected to increase only slightly in areas where vegetation treatments remove 25 to 50 percent of the overall tree canopy cover within a given watershed (Troendle et al. 2001, Burton 1997, Swank 1989, Baker 1999, 2003, Ffolliott et al. 1989, Miller 2007). Snow interception by tree canopies would be reduced, leading to increased snowpack in forest openings.	Water yield would be expected to be slightly higher than under alternative B. There would be more forest openings and less dense forest conditions. Snow interception by tree canopies would be reduced, increasing the winter snowpack.	Same as alternative B.
Surface Water Quality	There are no impaired streams within the project area. A segment of Oak Creek (0.25 mile) is outside of the project boundary, downstream of the treatment area, and listed as impaired.	Meet Arizona Department of Environmental Quality (ADEQ) water quality standards.	No change. There would be the potential for adverse effects from wildfire.	Short-term adverse impacts from soil disturbance would average 3.3% at the 6^{th} code HUC scale. There would be long-term improvement.	Short-term adverse impacts from soil disturbance would average 3.4% at 6^{th} code HUC scale. There would be long-term improvement.	Short-term adverse impacts from soil disturbance would average 2.9% at 6^{th} code HUC level. There would be long-term improvement.

Indicator	Existing Condition	Desired Condition	Alternative A	Alternative B	Alternative C	Alternative D
Riparian Areas	There is reduced water yield. Ponderosa pine is compromising the integrity of riparian areas by reducing spring discharge rates and stream channel flow.	Vegetation, landforms, soil condition, and woody debris dissipate water energy, filter sediment, capture bedload, and contribute to favorable flood plain development. There is improved floodwater retention and groundwater recharge.	Reduced riparian area and wetland function are possible under alternative A.	Riparian and wetland function would improve through increased groundwater recharge, improved surface flows, and spring restoration.	Riparian and wetland function would improve slightly more than under alternatives B and D since more acres would receive mechanical vegetation treatments than in alternative B.	Riparian and wetland function would improve under alternative D, but to a lesser degree than under alternatives B and C. Fewer acres would receive prescribed fire. Fire would have reduced vegetative cover which would reduce rainfall interception, and evapotranspirational losses.

Indicator	Existing Condition	Desired Condition	Alternative A	Alternative B	Alternative C	Alternative D
Soil Productivity and Function						
Soil Erosion/Soil Productivity	See chapter 3 "Soils" section and soils report for details.	Long-term soil productivity is protected by maintaining or improving soil condition and function. Soil condition and function is maintained or improved toward satisfactory. Maintain soil disturbance below target threshold level (15%). See chapter 1 for detailed desired conditions	Soil disturbance would range from 0 to 33% due to fire risk. There would be no improvement or protection of soil condition and productivity.	Alternatives B–D: No watershed would have soil disturbance above 11%, which is 4% below the 15% threshold. Therefore, soil productivity should be maintained at the watershed level. Thinning stands and prescribed burning would increase understory response on about 388,500 acres. Using prescribed fire only on about 199,400 acres would decrease wildfire threat and improve soil condition and productivity on about 587,923 acres.		
Landscape-Scale Forest Resiliency and Function	Alternative A would not increase forest resiliency to natural disturbances and would not improve soil or watershed function because watersheds would be at risk of continued uncharacteristic wildfires. Alternatives B, C, and D would maintain or improve long-term soil productivity and watershed function. Vegetation treatments at the watershed scale combined with prescribed burning could restore or improve hydrologic function of 74 springs and select channels.					

*LOPFA – landscapes outside of goshawk post-fledgling family areas or non-PFAs.

Chapter 3 – Affected Environment and Environmental Consequences

This chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented here. Only summaries are provided for each resource and all resource reports are incorporated by reference. Most specialist reports will be available for viewing on the 4FRI Web site: http://www.fs.usda.gov/4fri. Those not on the Web site can be made available upon request.

Soils and Watershed

The soils specialist report (Steinke 2013) and water quality and riparian report (MacDonald 2013) are incorporated by reference. See the reports for detailed information including methodology, soil disturbance by treatment type, treatment area, and 6^{th} hydrologic unit code (HUC) watersheds, the disturbed Water Erosion Prediction Project (WEPP) soil erosion modeling runs, soil interpretations by 6^{th} HUC watershed, strata, and terrestrial ecosystem survey (TES) map units, and the data used to evaluate the cumulative effects to soil disturbances.

Affected Environment

Soils

Approximately 94 TES map units were aggregated into 17 strata (specialist report, appendix B). The aggregation of strata was based on similar soils and vegetation types with similar limitations, hazards, and production potentials to management activities. The strata were used in part to design treatments, analyze effects, and are based on the potential plant community (hereafter referred to as PPC) and capability of the soils. Short term for soils is considered 3 years (when leaf fall occurs) up to 10 years. Long term is considered greater than 10 years.

Soil Erosion

Forests generally have very low erosion rates unless they are disturbed. Common disturbances include prescribed fire, wildfire, and harvesting operations. Vegetative recovery after fuel treatments is generally very rapid, with erosion rates typically dropping to pre-fire levels within 1 to 2 years (Elliot et al. 2010). After that, the rapid regrowth of vegetation soon covers the surface with plant litter, and potential erosion is quickly reduced. In one study, Robichaud and Brown (1999) reported that erosion rates dropped from almost 40 Mg ha^{-1} (megagrams per hectare) the 1st year after a fire to 2.3 Mg ha^{-1} the 2nd, and 1 Mg ha^{-1} the 3rd year. If the year is normal or dry, then it is unlikely for there to be any significant erosion (Elliot 2000).

A (soil) tolerance soil loss rate is the rate of soil loss than can occur while sustaining inherent site productivity (TES 1995). Tolerable soil loss values are 2 to 4 tons per acre depending on soil type. Some steep slopes greater than 40 percent have soil inclusions with tolerable soil loss values equal to about 1 ton per acre, but the inclusions are generally minor in extent and generally occur on slopes that are less than 15 percent.

When soil loss exceeds tolerable amounts, soils erode faster than they renew themselves. This results in accelerated soil loss, loss of soil productivity, and delivers high amounts of sediment to connected stream courses. On slopes greater than about 40 percent, the TES identified tolerable limit is 2 tons per acre per year.

Soils in each TES ecological unit were assigned tolerance soil loss rates based on individual soil and climate properties and approximate annual soil renewability levels. Maintaining soil erosion below soil tolerance levels assures soil productivity will be maintained from an erosion standpoint.

Within the analysis area (988,764 acres), a total of approximately 133,850 acres (13 percent) are dominated by soils with severe erosion hazard. About 52,750 acres (5 percent) have soils dominated with moderate erosion hazard. Strata with slight erosion hazard equates to about 805,700 acres (81 percent). Resource protection measures are required to assure accelerated soil erosion and compaction do not impair soil productivity.

Most strata in the ponderosa pine type currently have closed stand structure (Steinke 2007ab, McCusker 2013, Lata 2013) with high canopy covers and densities that have reduced the understory forage productivity. However, there is generally sufficient vegetative ground cover to reduce accelerated erosion. Due to the closed stand structure, most strata have relatively high risk of crown fire that also pose a high risk of moderate or high burn severity to the watershed under normal or extreme fire behavior conditions as the current fire regime condition class (FRCC) in the analysis area is dominated by class 2 and 3 (see specialist report for 6th HUC watershed condition classification).

Soil Condition

Slopes Less than 40 Percent: Soil condition is satisfactory on about 841,500 acres (approximately 85 percent of the analysis area) due to the presence of high and adequate amounts of vegetative ground cover that protects the soil against accelerated erosion and compaction. The other 15 percent of the analysis area is dominated by impaired soils located on some montane meadows, and lesser amounts of inherently unstable/unsuited or unsatisfactory soils.

Although most soils rate out as satisfactory, nutrient cycling is reduced and soil conditions are close to being impaired in dense stands including those in Fire Regime Condition Class (FRCC) 2 and 3. In these areas, the amount of coarse woody debris (CWD) is not quantifiable.

Slopes Greater than 40 Percent: Soil condition on approximately 30,000 acres (strata 42, 43, 47, and portions of 44 and 45) is unsuited or inherently unstable where natural erosion exceeds tolerable erosion. These soils and strata are not suitable for mechanical timber harvesting and identified BMPs would need to be used to protect the soil resource when using prescribed fire.

Montane Meadows: Soil condition on slightly more than 50 percent of the montane meadow acres (strata 1, 2, 4, 6, and 10) are impaired on the Coconino NF and listed as satisfactory on the Kaibab NF (about 44,476 acres). However, it is probable that the soil condition in these montane meadows is impaired on the Kaibab NF. Soil condition in montane meadows located in strata 3, 5, 7, and 8 (about 38,744 acres) is satisfactory.

Wetlands: Strata 9 are wetlands where soil condition is rated as unsatisfactory on the Coconino NF. Most wetlands on the Kaibab NF are fenced to exclude livestock grazing in wetlands. Wetland soils on the Kaibab NF are generally impaired as a result of elk bedding and browsing (about 4,400 acres).

Pinyon-Juniper: Soil condition on pinyon-juniper vegetation types on slopes less than 40 percent (strata 46, about 1,000 acres) is variable and has areas of satisfactory, impaired, and a few areas of unsatisfactory soil condition. Impaired and unsatisfactory soil conditions generally have overstocked tree canopy, resulting in poor herbaceous understory composition and productivity, poor nutrient cycling function, low vegetative ground cover, and accelerated erosion.

Soil Classification

Soil classification varies by strata (see soils report, appendix B) and is dominated by forest soils in the Alfisol order (boralfs suborder), and grassland soils in the Mollisols order (borolls suborder), and ponderosa pine forests strata where stand density has drastically increased.

Based on soil type and field observations of tree canopy cover (which is variable but commonly exceeds 30 to 50 percent, a closed canopy state), age class, and old stump presence, mollisols (especially deep ones) probably historically supported grassy interspaces or open canopy covers (10 to 30 percent) and mollic integrade soils probably supported somewhat closed stands (slightly greater than 30 percent) on rocky or shallow soils and open stands on moderately deep and deep soils. See the specialist report for detailed soils information and a Coconino NF (Steinke 2007a) and Kaibab NF (Steinke 2007b) study on mollisol and mollic-integrade soils.

Watershed

Watershed Function

The project lies within 82 6^{th} code watersheds (see appendix C of the soils report). Fifth and 6^{th} HUC names, watershed condition class, and acres within and outside of the proposed treatment area (alternative B) are listed. The watershed condition framework (WCF) protocol (USDA 2010b) was used to classify watershed conditions at the 6^{th} HUC level in the spring of 2011 using 12 watershed indicators. The term “analysis area” refers to the larger 988,764-acre boundary.

Overall, the ponderosa pine vegetation type is dominated by functional at-risk 6^{th} HUC watersheds. This includes about 451,500 acres (46 percent of the analysis area) and about 1,214,339 acres, or about 59 percent of the entire 6^{th} HUC acreage associated with the project acres. There are several impaired watersheds, about 316,800 acres (about 32 percent of the analysis area) and about 458,391 acres, or about 22 percent of the entire 6^{th} HUC acreage associated with the project acres. There are a few properly functioning watersheds about 220,400 acres (about 22 percent of the analysis area) and about 394,285 acres, or about 19 percent of the entire 6^{th} HUC acreage associated with the project acres. Functioning condition was defined using 12 indicators to assess watershed condition through the WCF (USDA 2011). Watershed dysfunction in the treatment area is a result in large part from dense forests with FRCC 2 or 3, high density of road networks that can alter hydrology, road proximity to stream courses, and riparian condition less than functional and other factors.

The following 5th HUC watersheds have few to several 6^{th} HUC watersheds in the impaired function condition class totaling at least 33 percent of total 5th HUC area: Cataract Creek Rio de Flag, Spring Valley, Sycamore Creek, Upper Cedar Wash, and Walnut Creek. See appendix C in the specialist report for detailed condition class by 6^{th} HUC watershed and acres.

Water Quality and Quantity

The Arizona Department of Environmental Quality (ADEQ) 2006/2008 Impaired Waters List indicates there are no impaired streams within the project area. However, a segment of Oak Creek that is located approximately 0.25 mile outside of the project boundary and downstream of proposed treatment areas has been listed as impaired in the ADEQ 2006/2008 305(b) assessment report for two exceedances of the *Escherichia coliform* (E. coli) single sample maximum (SSM) water quality standard.

The ADEQ identified Upper and Lower Lake Mary as impaired for the presence of mercury in fish tissue. Although Upper and Lower Lake Mary are designated as domestic water sources, the levels of total mercury observed do not approach drinking water maximum contaminant levels. In 2002, the EPA added five lakes in the Lake Mary Region (LMR) to Arizona’s 303(d) List as impaired for mercury in fish tissue. These lakes included Upper and Lower Lake Mary, Soldiers, Soldiers Annex, and Lower Long Lakes and are all within the project area (ADEQ 2006, 2008).

Water yields from the ponderosa pine vegetation type are likely reduced from historic conditions due to increased stand densities that result in higher evapotranspiration rates.

Stream Courses

Approximately 2,197 miles of stream courses occur within the 988,764-acre analysis area, of which approximately 8.2 miles exhibit perennial flow. The three perennial stream segments within the analysis area include the Rio de Flag, Pumphouse Wash, and Sawmill Wash. Appendix B in the water quality specialist report lists stream reaches that occur within the analysis area and their associated lengths and flow regimes. The ephemeral stream courses are classified as intermittent in the National Hydrology Data.

There are approximately 77.5 miles of protected stream courses in the analysis area. These are areas where specific soil and water conservation practices (SWCP) and best management practices (BMPs) have been developed to prevent adverse impacts to stream courses (see the “Soils and Watershed” section of appendix C). Appendix G in the specialist report provides a list of the protected stream courses within the analysis area, their associated functional condition classes and lengths, and a map of the locations.

Riparian stream segments occur along 92.6 miles of streams within the analysis area. Of these, approximately 85.1 riparian miles (91 percent) occur on the Coconino NF and 7.5 riparian miles (9 percent) occur on the Kaibab NF. Appendix C in the specialist report provides a list of riparian areas by stream reach or name and their associated conditions within the analysis area. Within the analysis area, approximately 47.5 miles of streams are in proper functioning condition, 38.6 miles are functioning at risk, and 6.6 miles are nonfunctional.

Wetlands, Riparian Areas, Springs, Flood Zones, and Road Influences

There are 66 natural lakes, reservoirs, and natural wetland depressions within the analysis boundary that impound water for a sufficient duration to exhibit some wetland characteristics; therefore, they are listed in the U.S. Fish and Wildlife Service (FWS) National Wetlands Inventory database. See table 1 in appendix C of the water quality and riparian report for the list of riparian stream reaches in the analysis area, their associated lengths, and size and condition rating. Tables 1 and 2 in appendix D of the specialist report lists wetland habitats and their associated condition ratings.

There are approximately 145 springs located within the analysis area. Information regarding historic flow or water quality from these springs is minimal. Many springs exhibit downward trends or static-degraded conditions (MacDonald 2011). See the “Springs” section in chapter 1 for existing and desired condition information and appendix D in the specialist report for spring assessment information.

There are approximately 986,509 acres within the analysis area that are categorized into various flood zone types. See the specialist report for additional information.

Many roads in the analysis area are inadequately engineered or poorly located on the landscape and are consequently in a state of disrepair. See the “Transportation” section in chapter 1 for additional information on existing and desired road conditions.

Environmental Consequences

Soils and watershed environmental consequences are presented in both narrative and table format.

Soils and Watershed

Alternative A – Direct and Indirect Effects

According to the fire specialist report (Lata 2013), about 33 percent of ponderosa pine forest vegetation could burn under high-burn severity conditions. This varies slightly from WEPP soil erosion modeling, which indicated approximately 24 percent of all soils left untreated could be subject to soil erosion above tolerable levels from severe wildfires where all soils burned under a high burn severity condition. Based on recent wildfires, 33 percent is a good and approximate average of high-burn severity in wildfires from a watershed burn severity standpoint.

Therefore, if a 1,000-acre fire were to occur within the analysis area, approximately 200 to 300 acres of high-intensity fire could negatively affect soil properties. High-burn severity from Lata 2013 is an assessment of overstory vegetation and for this soil assessment, high severity is based on the vegetative ground cover present since that is what controls the runoff and watershed condition.

Assuming about 33 percent of wildfires would result in high-burn severity; about 8 percent of all soils in the approximate 595,000 treatment area could result in soil erosion above threshold levels resulting in loss of soil surface and soil productivity (table 32).

An increase in coarse woody debris (CWD) well above the forest standard of 5 to 7 tons per acre in ponderosa pine could contribute excessive ground fuel loads that would burn at high temperatures resulting in mineralization of surface soil horizon and organic matter where about 50 percent of soil nutrients are stored, sterilization, loss of ground cover, and hydrophobic soil conditions. Subsequently, post-fire storm events could result in removal of surface soil at an accelerated rate, loss of soil productivity, and sediment delivery into connected stream courses.

Implementation of alternative A would not increase forest resiliency to natural disturbances and would not improve soil or watershed function as well as all other action alternatives would. Implementation of alternative A would put the majority of soils and watersheds at risk of continued uncharacteristic wildfire effects that could result in loss of soil productivity and sediment delivery to connected stream courses. It does not meet the purpose and need for the project, as it would not move the project area toward soils (soil function/productivity and understory species), watershed or vegetation (forest structure, forest health, composition, and diversity), and fire behavior desired conditions.

Alternative B – Direct and Indirect Effects

Mechanical activities would not result in any soil loss above tolerable levels according to WEPP modeling. However, prescribed fire effects could result in potential soil erosion above tolerable levels on up to about 2 percent of mechanically, untreated slopes. Slopes greater than 40 percent are proposed for low-intensity prescribed fire only treatments (table 32).

Mechanical treatment and prescribed fire would increase understory response and reduce wildfire threat on about 388,500 acres. Using prescribed fire only on about 199,400 acres would decrease wildfire threat and improve soil condition and productivity. Overall, soil productivity would be improved and maintained on about 587,923 acres (table 33).

Alternative B would improve watershed conditions in 23 percent of the functioning at risk and 42 percent of the impaired watersheds (table 34). In addition, alternative B would decommission 496 miles of road in functioning at-risk watersheds, and decommission 226 miles of roads located in impaired function watersheds. Stream channel treatments would improve waterflow regime on 19 miles of functioning at-risk watersheds and 9 miles in impaired watersheds.

Alternative C – Direct and Indirect Effects

Mechanical activities would not result in any soil loss above tolerable levels according to WEPP modeling. However, prescribed fire effects could result in potential soil erosion above tolerable levels on up to about 2 percent of mechanically, untreated slopes. Slopes greater than 40 percent are proposed for low-intensity fire only treatments (table 32).

Mechanical treatment and prescribed fire would increase understory response and reduce wildfire threat on about 434,000 acres. Using prescribed fire only on about 159,200 acres would decrease wildfire threat and improve soil condition and productivity. Soil productivity would be improved and maintained on about 593,211 acres (table 33).

Alternative C would slightly improve watershed conditions on 23 percent of the functioning at risk and 42 percent of the impaired watersheds (same as alternative B) due to fuels reduction and improved soil productivity from treatments (table 34). Roads and stream channel related effects are the same as described for alternative B.

Alternative D – Direct and Indirect Effects

Mechanical activities would not result in any soil loss above tolerable levels according to WEPP modeling. However, prescribed fire effects could result in potential soil erosion above tolerable levels on up to about 2 percent of mechanically, untreated slopes. Slopes greater than 40 percent are proposed for low-intensity fire treatments with no mechanical thinning (table 32).

Mechanical treatment and the use of prescribed fire only would increase understory response and reduce wildfire threat on about 388,500 acres (table 33). However, about 25 percent of those treated acres would be subject to high-severity surface fire effects that can compromise long-term soil productivity. The prescribed fire only treatment on about 179,000 acres would decrease wildfire threat and improve soil condition and productivity. Overall, soil productivity would be improved and maintained on about 470,148 acres.

Alternative D would move toward improved watershed function in 8 percent of the functioning at-risk watershed and within 34 percent of impaired watersheds (table 34). Roads and stream channel related environmental consequences are the same as described for alternative B.

Water Quality and Water Yield

Water quality units of measure are: (1) acres of soil disturbance that exceed tolerance thresholds, (2) acres subjected to high-severity burn, (3) acres of ephemeral stream courses restored, and (4) number of springs restored. The units of measure for water yield are: (1) increases in streamflow as measured at downstream gaging stations and (2) increases in snowpack retention as measured at SNOTEL sites and snow courses. For this analysis, short term equated to 1 to 2 years and long term is 5 years or more.

Alternative A

There would be no direct changes to surface water quality. Adverse effects to water quality, quantity, and riparian condition are possible from high-severity wildfire. There would be potential to increase flood flows of sediment and debris-laden storm water in stream courses within and downstream of burned areas. These conditions would adversely affect riparian areas along stream courses through deposition of large amounts of sediment and debris with the potential to damage or overwhelm riparian systems.

Water yield originating from the ponderosa pine vegetation type would continue to decline as a result of forest ingrowth that increases stand density. Increased stand density would result in a corresponding increase in interception of precipitation and evapotranspiration by trees, both of which would reduce soil moisture.

Alternative B

Minor, short-term changes (1 to 2 years) in water quality are possible in water bodies adjacent to or downstream from mechanical vegetation treatments, areas subjected to prescribed fire, areas of temporary road construction and decommissioning, and where stream channel restoration activities are conducted. Long term (5 or more years) surface water quality is expected to improve through more resilient forest conditions that minimize uncharacteristic fire behavior, and through improved vegetative ground cover that minimizes soil erosion and sediment transport to connected stream courses and other water bodies. Since soil disturbance at the 6th HUC level would average 3.3 percent and range from 0.1 to 11.2 percent (Steinke 2013), adverse effects to water quality would be minimal. Protective fencing around springs would improve surface water quality at the individual spring scale. BMPs and SWSCPs as outlined in appendix C of the DEIS would minimize or mitigate most adverse effects to water quality or riparian areas.

Water yield would be expected to increase only slightly in areas where vegetation treatments remove from 25 to 50 percent of the overall tree canopy cover within a given watershed (Troendle et al. 2001, Burton 1997, Swank 1989, Baker 1999, 2003, Ffolliott et al. 1989, Miller 2007). Snow interception by tree canopies would be reduced, leading to increased snowpack in forest openings.

Table 32. Alternatives A–D soil disturbance and erosion by treatment area and aggregate of 6th code watershed by alternative

Indicator	Acres by Alternative				Percent of Treatment Area by Alternative				Percent of 6th Code Watershed by Alternative			
	A	B	C	D	A	B	C	D	A	B	C	D
Soil disturbance from mechanical activities (%)	0	49,238	54,495	49,238	0	8.4	9.2	8.7	0	2.4	2.7	2.4
Soil disturbance from potential high-severity burns (%)		11,758	11,863	3,576	0	2.0	2.0	0.6	0 to 33	0.6	0.6	0.2
Total soil disturbance (high-severity burns and mechanical)		60,995	66,358	52,814	0 to 33	10.4	11.2	9.3	0 to 0.1–31.2	3.0	3.3	2.6
Soil disturbance from mechanical activities and high-severity fire (range: low to high)					NA	0–18.2	2.2–19.4	0.1–14.1	NA	0–11.0	0.1–11.2	0.1–9.6
Potential soil erosion above tolerable soil loss values when 33% is burned in high-severity fire (%)		0	0	0	8	Up to 2	Up to 2	Up to 2	2	0	0	0
Potential soil erosion above tolerable levels when 100% are severely burned		0	0	0	24	Up to 2	Up to 2	Up to 2	5	0	0	0

Table 33. Soil condition and productivity environmental consequences by alternative

Improvement, Maintenance, and Protection of Soil Condition, Function, and Productivity	Alternative A	Alternative B	Alternative C	Alternative D
Acres treated for improvement, maintenance, and protection of soil condition and productivity	0	587,923	593,211	470,165
Increased herbaceous understory productivity (acres)	0	388,500	434,000	388,500 acres with 97,125 acres subject to high-severity surface fire effects that pose risk to long-term soil productivity.
Decreased fire threat, improved soil condition, and long-term productivity protected (acres)	0	587,923	593,211	470,165

Table 34. Comparison of effects to watershed function by alternative

Effects	Alternative A	Alternative B	Alternative C	Alternative D
Hazardous fuel reduction acres resulting in improvement, protection, and maintenance of soil condition and productivity (acres)	0	587,923	593,211	470,148
Potential for high-severity burns (acres/percent within treatment area)	200,000/34%	23,000 to 41,000/4 to 7%	Same as alternative B.	Short term: 23,000–41,000/4–7% potential for crown fire with surface fire intensity similar to alternative A on about 25% of mechanical treatment acres. Long term: 50% revert to FRCC 3.
Ephemeral stream restoration (miles)	0	39 miles of improvement: 19 miles in functioning at-risk watersheds, 11 miles in functioning proper	Same as alternative B.	Same as alternative B.

Effects	Alternative A	Alternative B	Alternative C	Alternative D
		watersheds, and 9 miles in impaired function watersheds.		
Road and route decommission (miles)	0	904 miles decommissioned: 496 miles in functioning at-risk watersheds, 182 miles in functioning properly watersheds, and 226 miles in impaired function watersheds.	Same as alternative B.	Same as alternative B.
Overall change (improvement and maintenance) in watershed function (Existing condition is 22% functioning properly, 46% functioning at risk, and 32% impaired.)	None—high percentages of functioning at risk and impaired watersheds continue.	Improvement in 23% of functioning at-risk watersheds. (This would equal almost a quarter of the 46% that are currently functioning at risk). Improvement in 42% of impaired watersheds. (This would equal almost half of the 46% of impaired watersheds.) 496 miles of open road reduced/removed in functioning at-risk watersheds. 28 miles of improved waterflow regimes: 19 miles would occur in watersheds that are functioning at risk and 9 miles that would occur in watersheds that are currently impaired.	Improvement in 23% of functioning at-risk watersheds. (This would equal almost a quarter of the 46% that are currently functioning at risk). Improvement in 42% of impaired watersheds. (This would equal almost half of the 46% of impaired watersheds.) Roads and stream channels are the same as alternative B.	Improvement in 18% of functioning at-risk watersheds. Improvement in 34% of impaired watersheds. Roads and stream channels are the same as alternative B. Alternative D would not improve overall watershed condition as extensively as alternatives B and C.

Alternative C

Minor, short-term adverse effects to water quality are possible in water bodies within and adjacent to mechanical vegetation and grassland restoration treatment areas. Steinke (2013) estimates soil disturbance of 3.4 percent at the 6^{th} HUC level and 10.9 percent across the treatment area. Overall effects to surface water quality would be similar to alternative B. BMPs and soil and water design features would minimize or mitigate most adverse effects to water quality or riparian areas.

More acres would receive mechanical vegetation treatments than alternative B and more trees would be removed from within Mexican spotted owl (MSO) protected activity areas (PACs) since trees up to 18-inch d.b.h. would be removed. Water yield would,therefore, be expected to be slightly higher than under alternative B since there would be more forest openings and less dense forest conditions. Snow interception by tree canopies would be reduced more under this alternative than under the proposed action, therefore, potentially increasing winter snowpack more than would occur under alternative B.

Alternative D

Soil disturbance that could adversely affect surface water quality is estimated to be 2.9 percent at the 6^{th} HUC level (Steinke 2013). While alternative D would result in the lowest level of soil disturbance that could adversely affect surface water quality of all the action alternatives, alternative D would not meet the purpose and need of achieving resilient forest conditions that promote high surface water quality (through protection of forested ecosystems from uncharacteristic fire behavior). Additionally, restoration of natural fire regimes to fire-dependent landscapes and vegetation types would not occur under this alternative. BMPs and soil and water design features would minimize or mitigate most adverse effects to water quality or riparian areas.

Mechanical vegetation treatments would result in similar effects as alternative B. Since there would be fewer acres prescribed burned, there would be reduced potential for runoff and sediment delivery to stream courses under alternative D.

Summary of Effects for Water Quality: Ephemeral and intermittent drainages in the project area typically respond to seasonal runoff events (spring snowmelt and short duration, high-intensity summer monsoon storms). Surface runoff has the potential to entrain sediment and other pollutants, contributing to short term surface water quality degradation. Sediment delivery ratios normally decline with increasing watershed area, resulting in dilution of sediment delivered to streams from a given activity. It is unlikely that alternatives B, C, and D would contribute enough sediment or other pollutants to ephemeral or intermittent drainages within the project area to result in impairment of any downstream waterbodies.

Springs, Riparian, and Wetland Condition

The units of measure for springs are: (1) initiation of spring discharge from springs that currently do not flow and (2) increases in spring discharge from currently flowing springs following restoration treatments. The units of measure for riparian and wetland condition are: (1) changes to the extents of riparian areas and (2) changes to riparian vegetative communities.

Alternative A

There would be no changes to spring condition. Reduced riparian area and wetland function would be possible. Ongoing reductions in water yield from the ponderosa pine vegetation type would decrease moisture reaching riparian areas since spring discharge rates would be further reduced and water would not reach stream courses or recharge shallow or perched aquifers.

Alternative B

Spring conditions would improve for up to74 springs. Vegetation treatments at the watershed scale combined with prescribed fire could restore or improve hydrologic function of springs that currently have reduced discharge due to evapotranspirational losses of soil water which could otherwise recharge groundwater in perched or shallow aquifers. Riparian and wetland function are expected to improve through increased groundwater recharge and improved surface flows. Decommissioning of roads that have altered flow patterns through increased drainage density (i.e., road ditches that intercept water and lead-out ditches that discharge concentrated ditch flow onto the forest floor) or redirected storm water runoff (i.e., roads and ditches that intersect stream courses and discharge storm water runoff directly to stream courses) would improve overall watershed hydrology, thus improving waterflow to riparian ecosystems. Spring restoration would improve riparian vegetation communities. Restoration of grassland ecosystems through removal of encroaching trees would improve hydrologic function in meadow ecosystems, potentially increasing riparian vegetation in these areas.

Alternative C

In alternative C, riparian and wetland function are expected to improve slightly more than under alternatives B and D since more acres would receive mechanical vegetation treatments than alternative B and more trees would be removed from within MSO PACs since trees up to 18-inch d.b.h. would be removed. More acres would be subjected to low severity prescribed fire, decreasing rainfall interception and evapotranspirational losses. Groundwater recharge and storm water runoff would be slightly higher than under alternatives B and D. Decommissioning of roads that have altered flow patterns or redirected storm water runoff would have the same effect as alternative B. Restoration of 74 springs would improve riparian vegetation communities in these areas. Since more acres of grassland would be restored under alternative C than alternative B, there is increased potential for improvement in riparian ecosystem function where wetland or riparian species occur in restored grasslands.

Alternative D

In alternative D, riparian and wetland function are expected to improve, but to a lesser degree than under alternatives B and C since fewer acres would be subjected to prescribed fire which would otherwise reduce vegetative cover and, therefore, rainfall interception and evapotranspirational losses. Decommissioning of roads that have altered flow patterns or redirected storm water runoff would have the same effect as alternative B. Restoration of 74 springs would improve riparian vegetation communities in these areas. Restoration of grassland ecosystems would have the same effect as alternative B.

Forest Plan Amendments

Alternative B and D

Coconino NF

Amendment 1 would result in removal of more trees in 18 MSO PACs since trees up to 16-inch d.b.h. could be removed in these areas. Removal of additional trees would improve vegetative ground cover over the long term by increasing light interception at the forest floor and providing conditions conducive to the establishment of a more vigorous understory of grasses, forbs, and shrubs. Increased vegetative ground cover would improve soil stability by reducing soil erosion rates. Reduced stand densities would also provide for improved protection of treated areas from the effects of high-severity fire, further improving overall soil stability and watershed conditions. Reduced evapotranspiration resulting from removal of trees up to 16-inch d.b.h. would likely improve soil moisture status. With implementation of measures outlined in appendix C of the DEIS, adverse effects to water quality and riparian function would be minimized. Overall, these effects would provide greater protection of water quality and riparian areas by reducing the potential for sediment delivery to stream courses and riparian habitats, improving soil moisture in upland areas, and improving snowpack retention in treated areas.

Without implementation of amendment 1, maintenance of soil productivity and, therefore, water quality and riparian conditions would not be to the level provided through implementation of the amendment. There would be 18 MSO PACs that would remain at risk of high-severity fire which could degrade soil stability and productivity increasing the risk of adverse effects to water quality and riparian function. Without implementation of this proposed amendment, soil productivity and watershed function, including downstream water quality, would remain at risk from high-severity wildfire and pose risk to the sustainability of PACs, core areas, restricted habitat, and threshold habitat. Deferring monitoring (and incremental treatment of habitat) of MSO to the FWS biological opinion would not affect water quality or riparian areas on the Coconino NF since no activities would occur that have potential to adversely affect these resources.

Amendment 2 would improve soils and watershed conditions on 29,017 acres within the Coconino NF since these treatment areas would be returned to open stand condition representative of historic or reference condition. The lower stand densities and increased interspaces would provide conditions conducive to the establishment of a more vigorous understory of grasses, forbs, and shrubs, thus providing greater soil protection than litter alone. The increased interspaces would likely improve snowpack retention and, therefore, soil moisture status. Lower stand densities would provide greater protection of soils and watershed resources in treated areas from the effects of high-severity wildfire. These conditions would improve water quality and riparian area conditions by reducing sediment delivery to stream courses and riparian areas.

Implementation of measures outlined in appendix C of the DEIS would minimize or mitigate any adverse effects to water quality and riparian function. Without implementation of amendment 2, approximately 29,017 acres on the Coconino NF would remain at an elevated risk of high-severity wildfire. If such a fire were to occur, surface water quality would likely be adversely affected through increased sediment deliver and turbidity. Sediment delivery to riparian areas could degrade riparian function.

Amendment 3 is intended to ensure that no adverse effects occur to significant, or potentially significant, inventoried heritage sites. By doing so, this amendment would improve soils and watershed resources and, therefore, water quality and riparian area conditions by minimizing disturbance of these sites. While inventoried heritage sites comprise a relatively small proportion of each watershed, reduced ground disturbance would prevent destabilization of soils resources and, therefore, sediment delivery to stream courses and riparian areas. Implementation of BMPs and SWCPs that are designed to minimize or mitigate adverse impacts to soils and water quality would further prevent degradation of soil stability and productivity and, therefore, minimize adverse effects to riparian areas.

Without implementation of amendment 3, adverse effects to inventoried heritage sites and, therefore, soil stability could occur. If soils are destabilized, sediment delivery to connected stream courses and riparian habitats could occur.

Kaibab NF

Amendment 1 would have similar effects as the Coconino NF plan amendment 2 under this alternative although slightly fewer acres (27,637) on the Kaibab NF would be managed for open conditions that are representative of historic or reference conditions that are conducive to the establishment of a more vigorous understory of grasses, forbs, and shrubs that then protect soil surfaces and reduce sediment delivery to stream courses and riparian areas. Without implementation of Kaibab NF plan amendment 1, maintenance of soil productivity and, therefore, water quality and riparian conditions would not be to the level provided through implementation of the proposed amendment. Approximately 27,637 acres would remain at risk of adverse effects of high-severity fire which could degrade soils stability and productivity and adversely affect surface water quality and riparian habitats.

Amendment 2 would have no effect to water quality or riparian areas on the Kaibab NF since it strictly relates to monitoring, definitions, and the incremental treatment of habitat. Managing for less than 10 percent threshold habitat for MSO would have minimal effect on soils, watershed condition, water quality, and riparian areas as this represents a difference of only 2 percent from the current level of 8 percent.

Alternative C

Coconino NF

Amendment 1 would have similar effects as amendment 1 under alternative B. However, under this alternative, soils and watershed resources would be further improved in 56 MSO PAC core areas as a result of reintroduction of low intensity prescribed fire to these PACs. Reduced stand densities followed by improved vegetative ground cover would increase fine root biomass of grasses, forbs, and shrubs that protect soils from erosion. Reintroduction of low-intensity fire would improve nutrient cycling and increase understory vegetative vigor. These conditions would improve water quality and riparian area conditions by reducing sediment delivery to stream courses and riparian areas.

Overall, amendment 1 under alternative C would provide greater improvement in water quality and riparian health that under alternative B. Without implementation of this proposed forest plan amendment, reintroduction of low severity prescribed fire would not occur in 56 MSO PACs, leaving soils and watershed resources at risk of uncharacteristic wildfire that could damage soil stability and productivity and, therefore, adversely affect surface water quality and riparian area conditions.

Mechanical vegetation treatments within the 6,321 acres of MSO restricted habitat (target/threshold) to achieve a residual basal area ranging from 110 to 150 square feet would improve soils and watershed conditions and, therefore, water quality by reducing stand densities that are otherwise conducive to high-severity fire. Vegetative ground cover would improve in these areas, reducing soil erosion potential and protecting surface water quality.

Deferring monitoring (and incremental treatments of habitat) of MSO to the FWS biological opinion would not affect water quality or riparian areas on the Coconino NF since no activities would occur that have potential to adversely affect these resources.

Amendment 2: The effects under alterative C would be the same as those described under alternative B.

Amendment 3: The effects under alternative C would be the same as those described under alternative B.

Kaibab NF

Amendment 1 under alternative C is similar to amendment 1 under alternative B, although 38 more acres would be managed for open conditions that are representative of historic or reference conditions. The historic, reference conditions are conducive to the establishment of a more vigorous understory of grasses, forbs, and shrubs that would protect soil surfaces from erosion and reduce sediment delivery to stream courses and riparian areas. Approximately 38 additional acres would be improved under alternative C than alternative B. Without implementation of this proposed amendment, 27,675 acres on the Kaibab NF would remain at an elevated risk of high-severity wildfire that could adversely affect water quality and riparian habitats through increased sediment delivery to stream courses and increased water turbidity.

Amendment 2 would improve soils and watershed conditions in the proposed Garland Prairie Research Natural Area (RNA) by returning the RNA to a grassland condition. Removal of encroached trees would improve vegetative ground cover in this treatment area, reducing the potential for soil erosion and sediment delivery to stream courses. There would be minimal effect to riparian areas from implementation of this amendment as there are no riparian areas in close proximity to the RNA. Reintroduction of low intensity prescribed fire would improve nutrient cycling and herbaceous understory vigor, further contributing to improved vegetative ground cover. Without implementation of this amendment, encroached trees in the proposed Garland Prairie RNA would continue to pose a risk of high-severity fire and, therefore, risk to water quality in connected ephemeral drainages.

Amendment 3 would allow mechanical vegetation treatments within the 2,090 acres of MSO restricted habitat (target/threshold) to achieve a residual basal area ranging from 110 to 150 square feet. This amendment would improve soils and watershed conditions and, therefore, water quality by reducing stand densities that are otherwise conducive to high-severity fire. Vegetative ground cover would improve in these areas, reducing soil erosion potential and protecting surface water quality. Managing for less than 10 percent threshold habitat for MSO would have minimal effect on soils, watershed condition, water quality, and riparian areas as this represents a difference of only 2 percent from the current level of 8 percent.

The amendment adds definitions and defers MSO monitoring and the incremental treatment of habitat to the FWS biological opinion. Amendment 3 under alternative C would not affect water quality or riparian areas on the Kaibab NF since no activities would occur that have potential to adversely affect water quality or riparian habitats.

Cumulative Effects

The spatial boundary for the soils and watershed cumulative effects analysis is the 82 6th HUC watersheds that total about 2,032,000 acres (see appendix C of the soils report). The temporal timeframe for past actions is 2 to 3 years based on vegetative and CWD recovery of the site. Vegetative recovery after fuel treatments is generally very rapid, with erosion rates typically dropping to pre-fire levels within 1 to 2 years (Elliot 1999, USDA 2000).

Relative to soils and watershed, there are about 45,000 acres of baseline ground disturbance from roads, private land, grazing allotments, and powerline corridors that occur across the cumulative effects analysis area. The total acres of past, present, and reasonably foreseeable treatment acres within the cumulative effects project area are roughly 282,400 acres (133,000 past and present projects and 150,000 acres of reasonably foreseeable projects) or about 14 percent of the cumulative boundary area. Of these treatment acres, about 15 percent would have ground disturbance (42,400 acres), which is just under 2 percent of the cumulative effects analysis area. The 4FRI project could add an additional 61,000 acres of ground disturbance. The total acreage of disturbed ground would be nearly 148,396 acres, or about **7** percent of the cumulative effects boundary area (see table 35).

Alternative A

Because no actions are proposed, no direct cumulative effects would result. The spatial and temporal boundaries are the same for all alternatives.

Alternatives B, C, and D

In alternative B, when past, present, and reasonably foreseeable actions are considered, including the actions in this alternative, the extent (about 5 percent) and magnitude of soil disturbance would not be exceeded within the cumulative effects boundary (table 35).

In alternatives C and D, the baseline ground disturbance and past, present, and foreseeable activities are the same as described in the introduction of the specialist report. Alternative C would add an additional 66,358 acres of ground disturbance for a total acreage of ground disturbance across the cumulative effects analysis area of nearly 153,759 acres, or about 8 percent of the cumulative effects boundary area (see table 35). Alternative D would add an additional 52,800 acres of ground disturbance for a total acreage of ground disturbance across the cumulative effects analysis area of nearly 140,200 acres, or about 7 percent of the cumulative effects boundary area (see table 35).

In alternatives B, C, and D, further protection of soil and water resources would be provided by the use of BMPs that minimize the potential for soil disturbance. Identified and implemented BMPs are expected to reduce the risk on accelerated erosion, sediment delivery, and nonpoint source pollution to connected stream courses and maintain water quality in all watersheds. In addition to the use of BMPs, the completion and implementation of the travel management EIS would further reduce the number of acres disturbed by closing and decommissioning roads within the cumulative effects boundary. Because of these facts, alternatives B, C, and D would not provide a detrimental cumulative effect to soil resources within the cumulative effects boundary.

In alternatives B, C, and D there are four 6th code watersheds where urban development has a large impact on ground disturbance areas. This project, plus current and reasonably foreseeable projects, would impacts these watersheds in the following manner:

- In the Cataract Creek headwaters watershed, there is an 11 percent baseline ground disturbance that increases to 14 percent total cumulative ground disturbance with the 4FRI proposed activities.
- In the Sinclair Wash watershed, there is a 25 percent baseline ground disturbance that increases to 26 percent total cumulative ground disturbance with the 4FRI proposed activities.
- In the Lower Rio de Flag watershed, there is an 18 percent baseline ground disturbance that increases to 20 percent total cumulative ground disturbance with the 4FRI proposed activities.
- In the Middle Oak Creek watershed, there is an 11 percent baseline ground disturbance that increases to 13 percent total cumulative ground disturbance with 4FRI proposed activities.

Implementation of BMPs would minimize any impacts to watersheds and would be especially important in the watersheds that already have a high urban impact.

Table 35. Total cumulative effects analysis area 6th code (acres) by alternative

Effect Indicators	Alt. B	Alt. C	Alt. D
Total Cumulative Effects Analysis Area 6th Code Acres	2,032,080	2,032,080	2,032,080
Proposed Ground Disturbance Acres	60,995	66,358	52,814
Percent of 6th Code Acres Disturbed	3.0	3.3	2.6
Baseline Conditions			
Baseline Ground Disturbance Acres	45,041	45,041	45,041
Total Treatment Acres	149,561	149,561	149,561
Future			
Total Ground Disturbance Acres	22,434	22,434	22,434
Current/Ongoing			
Total Treatment Acres	132,837	132,837	132,837
Total Ground Disturbance Acres	19,926	19,926	19,926
Project Totals			
Total Cumulative Effects Ground Disturbance (Acres)	148,396	153,759	140,214
Total Cumulative Effects Ground Disturbance (Percent)	7.3	7.6	6.9

Vegetation

The vegetation analysis is summarized from the silviculture specialist report. The report is incorporated by reference (McCusker 2013). The analysis is focused on determining whether, or to what degree, the project meets purpose and need objectives. It responds to two key issues: Issue 2, conservation of large trees and Issue 3, post-treatment canopy cover and landscape openness.

To address Issue 2, the analysis provides a quantitative pre-treatment and post-treatment three-level analysis for MSO, goshawk, old growth, and vegetation structural stage (VSS) for goshawk habitat at the landscape scale (ponderosa pine vegetation type) to gauge movement toward restoration desired conditions. To address Issue 3, the analysis discloses tree group stocking guides that will be used to meet tree group canopy cover requirements and evaluates the following within goshawk habitat: pre- and post-treatment distribution of habitat structure, overall habitat structure (VSS class), forest density metrics, and openness. See the silviculture report for the complete methodology, assumptions, and limitations discussion.

Affected Environment

Cover Types and Vegetation Communities

The cover types have been grouped into communities. Table 36 lists the acres within the project area by cover type. The “Forest Structure” and “Forest Health” sections in chapter 1 include existing and desired conditions for ponderosa pine and pinyon-juniper woodlands (old growth). Existing and desired conditions for grasslands, Gambel oak , and aspen can be found in the “Vegetation Composition and Diversity” section. See the specialist report for details on each vegetation community.

Table 36. Acres of vegetation cover types by restoration unit (RU) in the project area

Cover Type	RU 1	RU 3	RU 4	RU 5	RU 6	Total
Nonvegetated						
Barren	120	134	129	1,301	48	**1,732**
Nonforest Communities						
Grassland	8,230	12,799	22,665	4,987	93	**48,774**
Forest Communities						
Pinyon-Juniper Woodland	1,427	5,884	7,283	8,845	2,219	**25,658**
Oak Woodland	287	1,633	926	523	30	**3,399**
Ponderosa Pine	145,793	129,225	134,301	61,671	41,188	**512,178**
Aspen	368	201	499	403	0	**1,471**
Total Forested Acres:	**147,875**	**136,943**	**143,009**	**71,441**	**43,437**	**542,705**
Total Analysis Area Acres:	**156,225**	**149,876**	**165,803**	**77,730**	**43,578**	**593,211**

All ponderosa pine forested habitat within the analysis area was stratified to meet analysis requirements in the forest plans (USDA 1987, 1988) for MSO and northern goshawk as displayed in figure 35, table 37, and table 38. See the “Wildlife” section for the MSO and goshawk analysis.

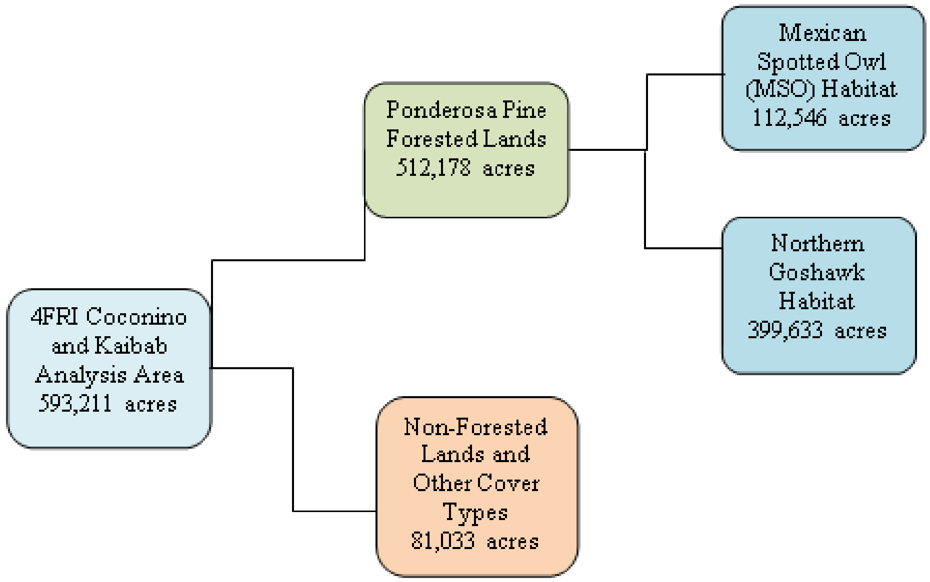


Figure 35. Stratification of ponderosa pine forested lands, other cover types, and nonforested land

Table 37. MSO habitat stratification within the analysis area (acres by RU)

MSO Habitat	RU 1	RU 3	RU 4	RU 5	RU 6	Total
Protected Habitat						
Protected Activity Center (PAC)	29,349	4,268	556	1,393	0	35,566
Pine Oak >40% Slope	648	239	3	0	0	889
Total MSO Protected	29,996	4,507	558	1,393	0	36,455
Restricted Habitat – Pine Oak						
Threshold	873	1,032	0	0	0	1,905
Target	3,941	2,867	0	0	0	6,808
Restricted Other	26,421	38,748	1,575	634	0	67,378
Total MSO Restricted	**31,234**	**42,648**	**1,575**	**634**	**0**	**76,091**
Total MSO Habitat	**61,231**	**47,155**	**2,134**	**2,026**	**0**	**112,546**

Table 38. Northern goshawk habitat stratification within the analysis area (acres by RU)

Northern Goshawk Habitat	RU 1	RU 3	RU 4	RU 5	RU 6	Total
Nest Habitat	1,126	1,174	3,489	435	616	6,839
Post-fledgling Family Area (PFA)						
Uneven-aged	650	2,405	5,086	1,362	2,852	12,354
Even-aged	2,895	1,873	4,910	1,148	582	11,408
Total PFA	**3,545**	**4,278**	**9,996**	**2,509**	**3,434**	**23,761**
Total PFA and Nest	**4,670**	**5,452**	**13,484**	**2,944**	**4,050**	**30,600**
Landscapes Outside Post-fledgling Family Areas (LOPFA)						
Uneven-aged	40,073	40,964	60,374	46,808	19,743	207,962
Even-aged	39,820	35,655	58,309	9,892	17,396	161,071
Total LOPFA	**79,892**	**76,619**	**118,683**	**56,700**	**37,183**	**369,033**
Total Goshawk Habitat	**84,562**	**82,071**	**132,167**	**59,644**	**41,188**	**399,633**

Forest Health

For the purposes of this analysis, forest health is defined by the vigor and condition of the forest stands, and the presence of insects and disease that affect the sustainability of the forest. Pages 17 to 18 in chapter 1 of the DEIS describe existing and desired conditions for stand density and insect and disease, key components of forest health.

Vegetation Diversity and Composition

Page 19 to page 21 in chapter 1 of the DEIS describe existing and desired conditions for vegetation composition and diversity.

Environmental Consequences

The spatial context for environmental consequences is the 593,211-acre analysis area (also referred to as the project area). The baseline year for existing condition is 2010. The baseline description includes all past activities and events that have influenced the existing condition. In the effects discussion, post treatment refers to the time the final activity is accomplished (year 2020), “short-term” effects refers to effects over the 10-year period from the time the final activity was accomplished (year 2030). Beyond 20 years, effects are considered “long term” (year 2050). The environmental consequences are based on the application of the design features and mitigation measures (see sections A through E of appendix D for the vegetation treatment design and associated implementation guides).

All Alternatives

Canopy Density and Openness

In alternative A and in the absence of restoration treatments, existing openness is expected to continue on the same trajectory with at least 75 percent of the ponderosa pine classified as moderately closed to closed by 2020 (table 39). As the forest develops over time and existing openings gradually fill in, some of the areas would move from an open to moderately closed condition and some of the areas would move from a moderately closed to closed condition. No treatments would be implemented to create a mosaic of interspaces and tree groups. Existing interspace would continue to be encroached upon by expanding tree crowns and ingrowth. Any large scale tree mortality occurring has the potential to enhance interspace and create tree groups.

In alternatives B and D there would be a fairly diverse condition with openness leaning to the closed side of the range. Eleven percent of the ponderosa pine would be very open, 31 percent open, 42 percent moderately closed, and 15 percent closed (table 39). The unknowns are those areas with no treatment proposed under this alternative.

In alternative C, there would be a fairly diverse condition with openness leaning to the closed side of the range. Eleven percent of the ponderosa pine would be very open, 30 percent open, 42 percent moderately closed, and 17 percent closed.

In addition to this analysis, wildlife conducted an evaluation of post-treatment canopy openness for canopy density dependent species. The analysis is summarized in the "Wildlife" section. The complete analysis is in appendix G of the DEIS.

Table 39. Alternatives A–D comparison of canopy density and openness

Alternative	Very Open (%)	Open (%)	Moderately Closed (%)	Closed (%)
Alternative A	45% moderately closed and 3% closed trends toward being 75% closed by 2020			
Alternative B	11	31	42	15
Alternative C	11	30	42	17
Alternative D	11	31	42	15

Mosaic of Interspaces and Tree Groups of Varying Sizes and Shapes

While all treatments with the exception of grassland restoration are designed to reestablish forest openings and attain a mosaic of interspaces and tree groups of varying sizes and shapes, the intensity of the treatment affects the relative tendency toward this condition.

In alternatives B and C, 41 percent of the area treated would be considered high, 25 percent would be moderate, 24 percent would be low, and 10 percent would be very low. In alternative D, 43 percent of the area treated would be considered high, 26 percent would be moderate, 25 percent would be low, and 6 percent would be very low.

The lower intensity treatments within MSO PACs, target/threshold, and goshawk nest habitat would result in irregular tree spacing and subtle expansion of existing forest openings. The higher intensity treatments such as uneven-aged (UEA) 40, intermediate thin (IT) 40, and stand improvement (SI) 40 would be removing more trees and extends greater flexibility in size and shape of interspaces and tree groups generated.

Table 40 displays by alternative acres by treatment intensity as an indication of the relative ability of the treatment to attain a mosaic of interspaces and tree groups and of the post-treatment interspace/tree group condition. Total treatment acres and percent are provided by treatment intensity category (high, moderate, low, and very low).

Table 40. Comparison of alternatives relative to attaining interspaces and tree groups (acres)

Treatment Intensity	Treatment Type	Alt. B	Alt. C	Alt. D
High	Grassland Restoration	11,185	11,230	11,222
	Savanna	45,469	45,462	45,469
	Pine-Sage	5,261	5,261	5,261
	WUI 55	2,268	2,268	2,268
	UEA 40	101,044	95,712	101,044
	IT 40	39,189	39,039	39,189
	SI 40	12,309	12,244	12,309
High (Total Acres and Percent)		**216,725 (43%)**	**211,215 (41%)**	**216,762 (44%)**
Moderate	MSO Restricted	65,024	63,191	65,024
	UEA 25	39,244	39,176	39,244
	IT 25	11,871	11,858	11,871
	SI 25	6,824	6,824	6,824
Moderate (Total Acres and Percent)		**122,963 (24%)**	**121,050 (24%)**	**122,963 (25%)**
Low	UEA AZGFD Design	NA	4,837	NA
	UEA 10	18,204	18,109	18,204
	IT 10	7,766	7,766	7,766
	SI 10	1,914	1,914	1,914
	Goshawk PFA and LOPFA Prescribed Fire Only	90,126	91,057	90,089
	MSO Restricted Prescribed Fire Only	2,354	2,354	2,354
Low (Total Acres and Percent)		**120,363 (24%)**	**126,074 (25%)**	**120,327 (25%)**
Very Low	Goshawk Prescribed Fire Only	6,839	6,839	6,839
	MSO PAC	10,741	10,741	10,741
	MSO Protected Prescribed Fire Only	20,864	25,714	889
	MSO Target and Threshold	8,412	8,412	8,412
	MSO Target and Threshold Prescribed Fire Only	301	301	301
Very Low (Total Acres and Percent)		**47,157 (9%)**	**52,007 (10%)**	**27,182 (6%)**

Forest Structure in Goshawk Habitat

Goshawk habitat forest structure and habitat components were projected out to the years 2020 and 2050 by habitat and restoration unit (RU) scale. Table 41 summarizes the differences in habitat components by alternative. The silviculture report includes additional scales of analysis including restoration subunit.

In alternative A, density in terms of stand density index (SDI) and basal area would continue to increase and remain higher than desired in all habitats. All habitats would show an increase in total CWD, CWD >12 inches, and snags >18 inches between 2020 and 2050 resulting in conditions at or close to desired.

In alternatives B and C in year 2020, all habitats would be within the desired density range with the exception of RU 6 PFA. The pre-treatment RU 6 PFAs would have low stocking (below the desired condition of 70 square feet), typical of RU 6 site conditions with patches of dense VSS 3. The treatments would focus on thinning the dense patches and maintaining canopy cover in the mid-aged, mature, and old (VSS 4, 5, and 6), further reducing overall density. Tons of CWD and snags per acre would be below desired. By year 2050 at the habitat and RU scale, all habitats would remain within the desired SDI range. Basal area would be at or above the desired of 70 square feet. Tons of CWD would exceed the minimum desired with the exception of RU 6 PFA and LOPFA. Snags would remain below desired levels.

In alternative D (2020) at the habitat and RU scale, all habitats would be within the desired density range with the exception of RU 6 PFA (due to these stands being dominated by young forest structural stage). With the exception of RU6 and LOPFA RU 5, tons of CWD would be at or above desired due to the lack of prescribed fire reducing this attribute. Snags per acre would be below desired at all scales. By year 2050, all habitats would remain within the desired SDI range. Basal area would be at or above the desired 70 square feet. Total tons of CWD would exceed the minimum desired with the exception of RU 6 PFA and LOPFA. Snags would have increased yet remain below desired levels.

Table 41. Goshawk forest structure and habitat components in 2020 and 2050 in all RUs

Alternative	SDI % of Maximum		Trees Per Acre		Basal Area		Tons CWD Total		Tons CWD >12”		Snags >18"	
	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050
Nest/PFA Habitat												
A	47	50	192	152	115	132	4.6	7.1	0.8	1.4	0.4	0.9
B	27	33	88	78	72	94	3.0	6.0	0.8	1.8	1.1	0.9
C	27	33	88	78	72	94	3.0	6.0	0.8	1.8	1.1	0.9
D	30	36	109	95	77	99	5.2	7.2	1.1	1.8	0.7	0.9
Landscapes Outside of PFAs												
A	43	46	182	142	105	122	4.2	6.6	0.6	1.2	0.4	0.8
B	21	27	67	60	57	76	2.7	5.0	0.6	1.4	1.0	0.9
C	21	27	67	60	57	76	2.7	5.0	0.6	1.4	1.0	0.9
Alt D	24	29	109	74	77	81	5.2	6.4	1.1	1.4	0.7	0.8

Table 42 characterizes the average overall habitat components in relation to desired (below, above, within) for each alternative.

Table 42. Forest structure desired conditions in goshawk habitat across alternatives

Indicator	Alternative A		Alternative B		Alternative C		Alternative D	
	2020	2050	2020	2050	2020	2050	2020	2050
SDI	Exceeds	Exceeds	RU 6 exceeds	Meets	RU 6 exceeds	Meets	RU 6 exceeds	Meets
Basal Area	Exceeds	Exceeds	RU 6 exceeds	Exceeds – Only RU 6 meets	RU 6 exceeds	Exceeds– only RU 6 meets	RU 6 exceeds	Exceeds
CWD (tons/ acre)	Moving toward	Meets	Below	Only RU 6 PFA and LOPFA meets	Below	Only RU 6 PFA and LOPFA meets	Below	Exceeds
Snags Per Acre	Moving toward	Meets	Below	Below	Below	Below	Moving toward	Exceeds

Canopy Cover

Canopy cover is time consuming to measure and difficult to standardize to obtain consistent results with different observers. Even the definition of the term is dependent on the method of measurement. To resolve this issue, the Forest Vegetation Simulation (FVS) crown width model was used as the basis for developing stocking densities that would achieve desired canopy cover levels. This was accomplished by establishing ponderosa pine seedling tree groups (site index 75) within FVS, and periodically thinning the groups to determine the stocking that would achieve the desired canopy cover when the trees reached 15-inch d.b.h. (midpoint of the VSS 4 size class). This stocking is considered typical for meeting the canopy cover desired conditions and stocking ranges by tree size class are centered on this value.

These stocking levels were compared to a local study specific to northern Arizona ponderosa pine forest (as reported by Shepperd et al. 2001) that predicted canopy cover at the stand level by inferring the relationship between estimated stand basal area and canopy cover. This comparison indicated the algorithmic relationship between basal area and canopy cover overestimated canopy cover in the larger size classes compared to FVS. Based on this comparison, we chose to use the stocking indicated by FVS to meet canopy cover requirements.

The FVS developed stocking guides were then validated thru site visits to areas with variable densities and tree sizes. Comparing the stocking guides to the tree density within VSS 4, 5, and 6 sites that had interlocking or nearly interlocking tree crowns indicated following the stocking guides would meet the desired tree group canopy cover within goshawk habitat.

Alternatives B, C, and D

Table 43 and figure 36 are the stocking guides that would be used in all action alternatives to meet canopy cover requirements in tree groups within goshawk LOPFA habitat. Table 44 and figure 37 are the stocking guides that would be used to meet canopy cover requirements in tree groups within goshawk PFA habitat. See sections A and B of appendix D for more detail on incorporating the stocking guides in treatment design. With the proposed canopy cover forest plan amendment for canopy cover (see appendix B of the DEIS) on both forests, the alternatives would be consistent with the forest plans.

The forest plan amendment specific to acres managed for an open reference condition would remove meeting the canopy cover requirement on a maximum of 29,017 acres of goshawk LOPFA habitat on the Coconino NF and 27,675 acres on LOPFA habitat Kaibab NF (alternative C).

Table 43. Stocking guides to meet tree group canopy cover requirements within goshawk habitat areas outside of PFAs (LOPFA)

		Typical Number of Trees Per Group Stocking for Different Group Sizes[1]					Typical Intra-group (within-group) Densities[1] (All Group Acreage Sizes)	
VSS	D.B.H. Range	1/10 Acre Group	1/4 Acre Group	1/2 Acre Group	3/4 Acre Group	1 Acre Group	Relative Spacing Range (feet)	Basal Area[2] (ft^2/acre)
1 & 2	0 – 4.9”	19	48	96	144	193	12 – 18	NA
3	5 – 11.9”	14	34	68	102	136	NA	50
4*	12 – 17.9”	5	12	23	35	46	NA	60
5*	18 – 23.9”	3	8	15	23	30	NA	70
6*	24”+	2	5	11	16	21	NA	85

[1] These are typical values for the desired condition. Variation can occur and is desired, however, ranges should center on these values. See chart below.
[2] Rounded to nearest 10 square feet per acre.
* Densities are equivalent to 40 percent canopy cover.

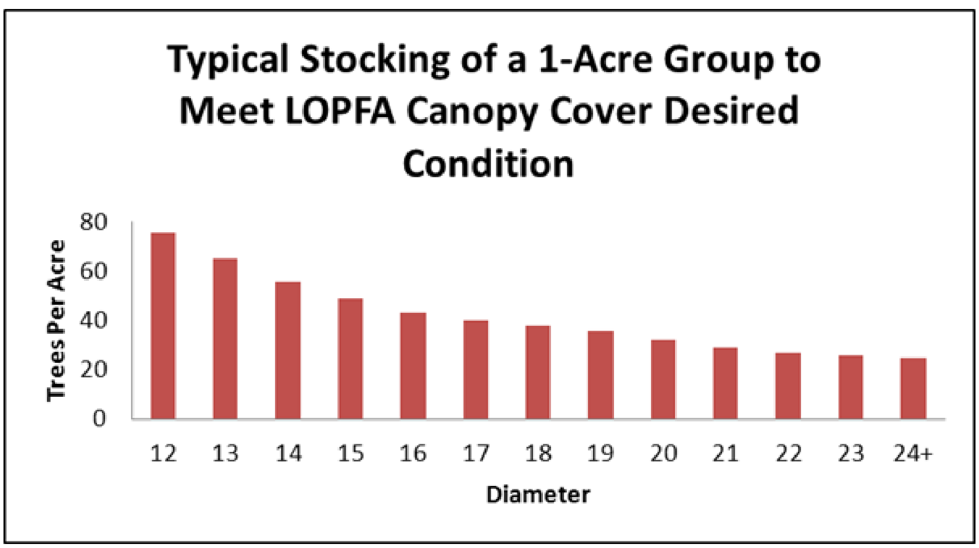


Figure 36. Typical stocking of a 1-acre group to meet LOPFA canopy cover desired condition

Table 44. Stocking guides to meet tree group canopy cover requirements within goshawk PFAs

VSS	D.B.H. Range	Typical Number of Trees Per Group Stocking for Different Group Sizes[1] 1/10 Acre Group	1/4 Acre Group	1/2 Acre Group	3/4 Acre Group	1 Acre Group	Typical Intra-group (within-group) Densities[1] (All Group Acreage Sizes) Relative Spacing Range (feet)	Basal Area[2] (ft^2/acre)
1 & 2	0 – 4.9”	19	48	97	145	193	12 – 18	NA
3	5 – 11.9”	14	34	68	102	136	NA	50
4*	12 – 17.9”	7	18	35	53	70	NA	85
5**	18 – 23.9”	4	10	20	29	39	NA	90
6**	24”+	3	7	14	20	27	NA	110

[1] These are typical values for the desired condition. Variation can occur and is desired, however, ranges should center on these values. See chart below.
[2] Rounded to nearest 10 square feet per acre.
* Densities are equivalent to 55 percent canopy cover
** Densities are equivalent to 50 percent canopy cover

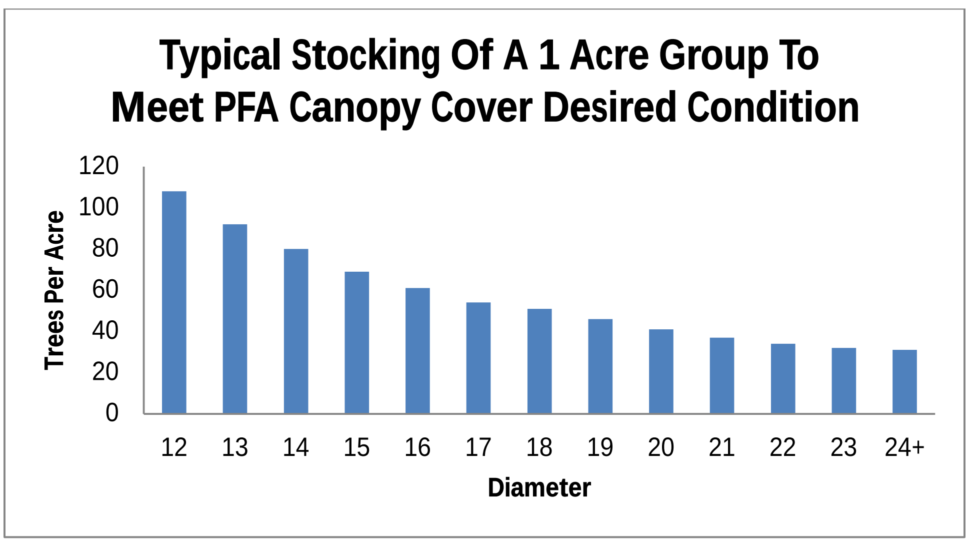


Figure 37. Typical stocking of a 1-acre group to meet PFA canopy cover desired condition

Forest Structure in Even-aged and Uneven-Aged Stands 2020 and 2050

Table 45 and table 46 summarize the differences in VSS distribution by alternative. The silviculture report includes additional scales of analysis including restoration subunit.

Alternative A

The goshawk habitat structural stage analysis indicates that in 2020, overall VSS distribution in all goshawk habitats would continue to be dominated by the young and mid-aged (VSS 3 and 4) structural stages. By 2050, this trend would shift toward the mid-aged and mature structural stages with an overall underrepresentation throughout all habitats in VSS 1, 2, 3, and VSS 6 in the even-aged stands.

Alternatives B and C

The goshawk habitat structural stage analysis for alternatives B and C indicates overall post-treatment VSS distribution in the even-aged goshawk habitats would have good representation of the VSS 1, 3, 4, and 5 age classes in the LOPFA; an underrepresentation of the VSS 5 age class in the PFA; an underrepresentation of the VSS 6 age class in all habitats; and no representation of the VSS 2 age class. The uneven-aged goshawk habitats would have good representation of VSS 1, 3, 4, 5, and 6 in the LOPFA; VSS 6 would be underrepresented in the PFA; and there would be no representation of the VSS 2 age class. This would represent a more balanced overall VSS distribution compared to alternative A with improvement toward the desired representation in the grass/forb/shrub, young, mid-aged, and mature forest stages.

As forest development progresses, projections show the distribution would shift toward the later stages by 2050 with no VSS 1 represented, an underrepresentation of VSS 3, and good overall representation in VSS 2, 4, 5, and 6.

Alternative D

The goshawk habitat structural stage analysis for alternative D indicates overall post-treatment VSS distribution to be similar to alternatives B and C, with slightly higher overall representation in VSS 3, and slightly lower overall representation in VSS 5. By 2050, projections indicate slight overall differences in representation in VSS 3, 4, 5, and 6 compared to alternatives B and C.

Table 45. Alternative A–D in 2020 and 2050 VSS distribution for goshawk LOPFA even-aged and uneven-aged stands (percent of area)

Alternative	VSS 1 (Desired 10%)		VSS 2 (Desired 10%)		VSS 3 (Desired 20%)		VSS 4 (Desired 20%)		VSS 5 (Desired 20%)		VSS 6 (Desired 20%)	
	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050
Even-aged LOPFA												
A	7	0	<1	7	35	8	49	47	7	32	2	5
B	13	0	0	13	20	3	39	29	24	34	3	21
C	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	40 (+1)	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B
D	Alt. B	Alt. B	Alt. B	Alt. B	32 (+12)	7 (+4)	33 (-6)	Alt. B	19 (-5)	36 (+2)	Alt. B	16 (-5)
Uneven-aged LOPFA												
A	0	0	1	0	36	8	34	42	14	25	16	25
B	7	0	<1	6	19	2	20	19	35	20	19	53
C	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B
D	Alt. B	Alt. B	1 (+<1)	Alt. B	26 (+7)	8 (+6)	Alt. B	Alt. B	29 (-6)	21 (+1)	17 (-2)	45 (-8)

Note: Cells with "Alt. B" indicate the value is the same as provided in alternative B and numbers in parentheses with a "+" or "-" symbol display the difference from alternative B.

Table 46. Alternatives A–D 2020 and 2050 VSS distribution for goshawk PFA even-aged and uneven-aged stands (percent of area)

Alternative	VSS 1 (Desired 10%)		VSS 2 (Desired 10%)		VSS 3 (Desired 20%)		VSS 4 (Desired 20%)		VSS 5 (Desired 20%)		VSS 6 (Desired 20%)	
	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050
Even-aged PFA												
A	3	0	1	3	36	7	52	58	7	26	1	6
B	9	0	0	9	24	2	45	42	14	38	8	9
C	Alt. B	Alt. B	Alt. B	Alt. B	25 (+1)	Alt. B	46 (+1)	Alt. B	Alt. B	Alt. B	6 (-2)	Alt. B
D	Alt. B	Alt. B	Alt. B	Alt. B	34 (+10)	5 (+3)	44 (-1)	40 (-2)	11 (-3)	37 (-1)	2 (-6)	Alt. B
Uneven-aged PFA												
A	0	0	<1	0	35	5	44	51	15	23	5	21
B	8	0	0	8	17	0	40	28	25	39	10	25
C	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B	Alt. B
D	Alt. B	Alt. B	Alt. B	Alt. B	25 (+8)	3 (+3)	37 (-3)	26 (-2)	24 (-1)	40 (+1)	6 (-4)	23 (-2)

Note: Cells with Alt. B indicate the value is the same as provided in alternative B
Note: Numbers in parentheses with a "+" or "-" symbol display the difference from alternative B

Forest Structure Mexican Spotted Owl Habit (MSO)

MSO habitat forest structure and habitat components projected out to the years 2020 and 2050 in each alternative and by habitat type are displayed in table 47.

Alternative A

Density in terms of basal area and SDI would continue to increase and would remain higher than desired in all habitats in 2020. By 2050, the distribution of size classes would exceed desired in the 12- to 18-inch and the 18- to 24-inch size classes, and would remain below desired in the 24-inch plus size class. Average trees per acre 18 inches and larger would be above 20 in all habitats except restricted other in RU 5 (see table 31 in the silviculture report). Average Gambel oak basal area would be static between 2020 and 2050 and remain below desired in the restricted other habitat. All habitats show an increase in CWD greater than12 inches and snags greater than18 inches between 2020 and 2050.

Alternative B

In 2020:

- Basal area density would be within the desired range in all habitats.
- SDI would be in the extremely high density zone within the target/threshold, protected habitats (with the exception of RU 4), and on the high end of the desired range within restricted other habitat. This would be largely due to the limited mechanical treatment in the protected habitat and the high oak stocking in the restricted habitat.
- The distribution of size classes would be at or exceed the desired minimum in the 12- to 18-inch and the 18- to 24-inch size classes in all habitats.
- Stocking in the 24-inch plus size class would exceed the desired minimum in the restricted other habitat and would be below desired minimum in the target/threshold habitat.
- Average trees per acre 18 inches and larger would be very close to desired minimum in the target/threshold habitat and well below desired minimum in restricted other.
- The overall average Gambel oak basal area would be above the desired minimum in all habitats but would be limited in RU 5 and RU 1 restricted other.
- All habitats would approach the desired minimum CWD greater than12 inches and would be below the desired minimum in snags greater than18 inches.

In 2050:

- Basal area would be above the desired minimum for target/threshold habitat and above the desired range for restricted other.
- The SDI would remain in the extremely high zone within the target/threshold and protected habitats and would be higher than the desired range in restricted other.
- The distribution of size classes would be at, or exceed, the desired minimum in the 12- to 18-inch and the 18- to 24-inch size classes in all habitats.
- Stocking in the 24-inch plus size class would exceed the desired minimum in the restricted other habitat and would remain below desired minimum in the target/threshold habitat.

- Average trees per acre 18 inches and larger would exceed the desired minimum in the target/threshold habitat and would remain below the desired minimum in restricted other.
- Overall, the average Gambel oak basal area would be above the desired minimum in all habitats but would remain limited in RU 5 and RU 1 restricted other.
- All habitats would show an increase in CWD greater than12 inches between 2020 and 2050. Snags greater than18 inches would show an increase in target/threshold and protected habitat while remaining static in restricted other.

Alternative C

In 2020:

- Basal area density would be within the desired range in all habitats.
- SDI would be higher than desired within the target/threshold, protected habitat (with the exception of RU 4), and on the high end of the desired range within restricted other habitat. This would be largely due to the limited mechanical treatment in the protected habitat and the high oak stocking in the restricted habitat.
- The distribution of size classes would be at or exceed the minimum desired in the 12- to 18-inch and the 18- to 24-inch size classes in all habitats.
- Stocking in the 24-inch plus size class would exceed the minimum desired in the restricted other habitat and would be below the minimum desired in the target/threshold habitat.
- Average trees per acre 18 inches and larger would be within 2 trees per acre of minimum desired in the target/threshold habitat and would be well below minimum desired in restricted other.
- Overall average Gambel oak basal area would be above minimum desired in all habitats except RU 5 restricted other where it would be a limited component within that landscape.
- All habitats would be approaching minimum desired CWD greater than12 inches and would be below minimum desired in snags greater than18 inches.

In 2050:

- Basal area would be above the desired range for target/threshold habitat. The average overall basal area in restricted other would be 112 square feet which is the low end of the desired range for MSO nesting/roosting habitat (threshold).
- SDI density would exceed the desired range in all habitats.
- The distribution of size classes would be at, or exceed, the minimum desired in the 12- to 18-inch and the 18- to 24-inch size classes in all habitats.
- Stocking in the 24-inch plus size class would exceed the minimum desired in the restricted other habitat and would remain below the minimum desired in target/threshold habitat.
- Average trees per acre 18 inches and larger would exceed the minimum desired in the target/threshold habitat and would remain below the minimum desired in restricted other.

- Overall average Gambel oak basal area would be above the minimum desired in all habitats except in RU 5 restricted other.
- All habitats would show an increase in CWD great than 12 inches between 2020 and 2050. Snags greater than18 inches would show an increase in target/threshold and protected habitat while remaining static in restricted other.

Alternative D

In 2020:

- Basal area density would be approaching the high end of the desired range within the restricted other habitat and would be within desired for the other habitats.
- SDI would be higher than desired in all habitats with the exception of restricted other RU 5 and protected RU 4. This would be largely due to the limited mechanical and fire treatments in the protected habitat and the high oak stocking and lack of post mechanical treatment burning in the restricted habitat.
- The distribution of size classes would be at or exceed the minimum desired in the 12- to 18-inch and the 18- to 24-inch size classes in all habitats.
- Stocking in the 24-inch plus size class would exceed the desired minimum in the restricted other habitat and would be below desired minimum in the target/threshold habitat.
- Average trees per acre 18 inches and larger would be very close to desired minimum in the target/threshold habitat and would be well below desired minimum in restricted other.
- Overall average Gambel oak basal area would be above desired minimum in all habitats except RU 5 restricted other where it would be a limited component within that landscape.
- All habitats would be approaching desired minimum CWD greater than12 inches and would be below the desired minimum in snags greater than18 inches.

In 2050:

- Basal area and SDI density would exceed desired in all habitats.
- The distribution of size classes would be at or exceed the desired minimum in the 12- to 18-inch and the 18- to 24-inch size classes in all habitats.
- Stocking in the 24-inch plus size class would exceed the desired minimum in the restricted other habitat and would remain below the desired minimum in the target/threshold habitat.
- Average trees per acre 18 inches and larger would exceed desired minimum in the target/threshold habitat and would remain below desired minimum in restricted other.
- Overall average Gambel oak basal area would be above desired minimum in all habitats but would remain limited in RU 5 restricted other.
- All habitats would show an increase in CWD greater than12 inches and snags greater than 18 inches between 2020 and 2050.

Table 47. Alternative A–D MSO habitat forest structure and habitat components projected to the years 2020 and 2050**

Alternative	Basal Area (BA)		SDI (% of maximum)		12.0–17.9″ (% of total SDI)		18.0–23.9″ (Avg. % of total SDI)		24.0″ + (Avg. % of total SDI)		Average Trees per Acre 18″+		Average Gambel Oak BA % of Total BA		Tons CWD >12″		Snags >18″	
	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050	2020	2050
Restricted Target/Threshold*																		
A	171	190	86	88	27	26	16	20	7	10	19.0	26.2	23	22	1.5	2.5	0.6	1.5
B	146	178	75	83	28	23	20	23	9	11	19.3	27.6	27	26	1.0	1.9	0.6	1.5
C	136	171	71	81	23	21	20	20	10	12	18.3	24.2	29	28	1.1	1.9	0.6	1.3
D	149	179	76	84	28	23	19	23	9	11	19.3	27.6	26	25	1.5	2.4	0.6	1.5
Restricted Other																		
A	147	169	72	76	30	28	14	20	7	10	14.1	22.7	17	18	0.7	1.5	0.5	1.1
B	78	111	37	49	22	19	22	19	18	19	11.5	17.0	22	21	0.8	1.6	0.9	0.9
C	78	112	37	49	22	19	22	19	18	19	11.4	17.0	22	21	0.8	1.6	1.0	0.9
D	91	127	46	58	20	18	20	17	17	16	11.9	17.0	23	22	1.1	1.6	0.5	0.9
Protected																		
A	164	181	80	81	31	28	16	22	8	11	17.8	27.5	12	12	1.1	2.4	0.7	1.7
B	154	175	72	76	32	27	17	24	9	12	18.0	28.2	13	13	0.8	2.1	0.7	1.7
C	152	174	71	75	32	27	18	25	9	13	18.1	28.4	13	14	0.7	2.1	0.7	1.7
D	159	178	74	77	32	28	17	24	9	12	18.0	28.0	13	13	1.1	2.3	0.7	1.7

*Restricted target/threshold is displayed as (average target/average threshold) a combined average.

**In comparison to table 7 in chapter 1, two additional evaluation categories have been included: average percent of total SDI by size class and average Gambel oak BA (percent of total BA).

Old Growth

Old growth allocations are based on current conditions within the project area along with forest plan specific management direction. Most sites currently do not fully meet the minimum criteria for old growth conditions as listed in the forest plans. However, the old growth allocated areas are closest to meeting old growth conditions. See chapter 1 for a detailed discussion of forest plan direction and old growth allocations within this project.

Alternatives A–D

In 2020 in ponderosa pine, the average conditions are at or above the minimum criteria with the following exceptions:

All alternatives (A–D):

- **Trees per acre larger than 18-inch d.b.h. and 180 years old**. This condition is deficit in all SUs. The age of these trees is estimated to be in the range of 100 to 140 years old.
- **CWD greater than 12 inches** is estimated to be deficit throughout RU 4 and 6, and in various SUs.
- **Snags per acre** are estimated to be deficit in RU 6.

Alternatives B, C, and D:

- **Trees per acre larger than 18-inch d.b.h. and 180 years old**. This condition would be deficit in all SUs. The age of these trees is estimated to be in the range of 100 to 140 years old.
- **Basal area per acre** would be below the minimum threshold of 90 square feet.
- **CWD greater than 12 inch**es would be deficit throughout RU 5 and 6, and in various SUs.

In all alternatives, ponderosa pine old growth conditions would improve over time in terms of meeting the minimum criteria. In 2050, all RUs would be very close to or exceed the minimum criteria for trees per acre larger than 18-inch d.b.h. with the exception of RU 6. The age of these trees is estimated be in the range of 130 to 170 years old. It is estimated that all the other criteria would be met throughout the allocated old growth acres.

In pinyon-juniper in 2020, the average conditions are at or above the minimum criteria with the exception of tree age and CWD. The age of the 12 inches and larger trees is estimated to be approximately 90 to 120 years old with a few relic trees approaching the 200-year-old criteria. The CWD would be slightly below the equivalent of two pieces per acre. By 2050, the average conditions on the old growth acres would meet or exceed the minimum criteria with the exception of tree age.

Forest Health

Bark Beetle

All Alternatives

Table 48 compares bark beetle hazard ratings by alternative. Alternative A has the highest hazard rating in both the short and long term. Alternatives B and C would have the highest percent of area with a low to moderate hazard rating in both the short and long term. Stands with a hazard rating of low or moderate would be expected to be resistant to successful bark beetle attack and large-scale mortality.

In alternative A, the overall hazard in 2020 is high across 83 percent of the analysis area. This increases to 92 percent in 2050. In alternatives B and C, the overall hazard in 2020 would be high across 26 percent of the analysis area. This would increase to 53 percent in 2050. In alternative D, the overall hazard in 2020 would be high across 45 percent of the analysis area. This would increase to 65 percent in 2050.

Table 48. Alternative A–D 2020 and 2050 bark beetle hazard rating

Hazard Rating	Alternative A Percent of Area	Alternative B Percent of Area	Alternative C Percent of Area	Alternative D Percent of Area
Low – 2020	4	39	38	28
Low – 2050	1	20	19	15
Moderate – 2020	13	36	36	26
Moderate – 2050	7	28	27	20
High – 2020	83	26	26	45
High – 2050	92	53	53	65

Dwarf Mistletoe

All Alternatives

Table 49 summarizes the change in infection level by alternative. In alternative A, by 2050 there would be an increase in the percent of area within the moderate/high infection level group and also an overall increase in the average percent of trees infected. This is an indication that mistletoe infection is intensifying and spreading over time. Alternative C would reduce the percent of moderate/high the most (8 percent reduction), followed by alternative B (6 percent reduction). The percentages for 2050 indicate mistletoe infection would intensify and spread at a slower rate in alternatives B, C, and D than alternative A, with alternative B and C providing the least intensification and rate of spread.

Table 49. Alternative A–D 2020 and 2050 dwarf mistletoe infection level by alternative

Infection Level		Alt. A		Alt. B		Alt. C		Alt. D	
		2020	2050	2020	2050	2020	2050	2020	2050
None/Low	Percent of Area	59	56	61	58	60	57	60	56
None/Low	Average Percent Trees Infected	7	7	6	7	6	7	6	7
Moderate/High	Percent of Area	41	43	39	42	40	43	40	44
Moderate/High	Average Percent Trees Infected	45	47	39	44	39	44	40	44
Extreme	Percent of Area	<1	1	<1	<1	<1	<1	<1	<1
Extreme	Average Percent Trees Infected	89	85	88	88	87	87	88	84

Large Tree/Old Forest Structure Sustained Over Time Across the Landscape

Alternatives B, C, and D

Restoration treatments proposed in alternatives B, C, and D are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Old trees would not be targeted for cutting. Reference the old tree implementation plan in appendix D of the DEIS.

The analysis presented for MSO indicates the post-treatment distribution of size classes has good representation in the 18- to 24-inch size classes in all habitats. Stocking in the 24-inch plus size class would have good representation in the restricted other habitat and would be underrepresented in the target/threshold habitat. The goshawk analysis indicates that mature and old forest structural stages that are currently underrepresented would trend toward improved representation in all habitats.

Treatments within areas currently allocated old growth would maintain existing old growth structural attributes and would be managed to move toward those conditions over time. The ponderosa pine old growth analysis above indicates old growth structural attributes would continue to develop and improve across the landscape.

The forest health discussion presents that the overall sustainability of the ponderosa pine forest would be improved across the landscape including the large/old tree component.

Vegetation Composition and Diversity

All Alternatives

In alternative A, ponderosa pine tree canopy would continue to increase, shading out understory herbaceous vegetation and further reducing forage production and species diversity. Historic grasslands, savannas, and forest openings would not be restored. Oak and aspen growth and vigor would continue to be stagnated due to competition with pine, resulting in lowered resistance to insects and disease and eventual mortality. Oak and aspen regeneration ability would continue to be impaired. Ponderosa pine tree canopy would continue to increase, shading out understory sage and further reducing the sage component and historic pattern within the pine-sage mosaic.

In alternatives B, C, and D, treatments would result in establishment of vigorous aspen regeneration free of competition from overtopping ponderosa pine. Treatments in pine-sage would result in enhancement of the sage component and restore the historic forest pattern within the pine-sage mosaic.

There would be improved vigor of existing oak and establishment of a variety of oak size and age classes across the landscape. Improved oak conditions would be most prevalent within the mechanically treated MSO restricted other habitat (65,024 acres in alternative B and 63,191 acres in alternative C). Overall, post-treatment oak basal area would be 5 percent higher in this habitat in alternatives B and C compared to the alternative A.

Alternatives B, C, and D treatments would restore historic grasslands, savannas, and forest openings by removing ponderosa pine tree canopy that is shading out understory herbaceous vegetation and reducing forage production and species diversity.

Other Direct and Indirect Effects

Residual Tree Damage

In alternatives B, C, and D, some damage to residual trees would be expected with the felling, tractor yarding, and piling operations associated with mechanical treatments in ponderosa pine. Alternative B would result in the most potential damage (386,762 acres), followed by alternative D (386,724 acres), and then alternative C (384,043 acres) (see table 50). Damage would be minimized through contract administration and proper harvest methods.

All piling and/or low-severity burning treatments would reduce understory stocking and reduce intertree competition as well as stimulate understory vegetation (shrubs, forbs, grasses).

Table 50. Alternatives B, C, and D residual tree damage

Ground-disturbing Actions	Alt. B	Alt. C	Alt. D
Felling, tractor yarding, piling	386,762 acres	384,043 acres	386,724 acres

Sustained Yield of Forest Products

In alternative A, there would be no beneficial effect of timber harvest (no biomass output) by meeting the Coconino and Kaibab forest plan goals of providing a sustained yield of forest products and providing a sustained level of timber outputs to support local dependent industries.

Timber harvest of 243,302,331 cubic feet of biomass from the Coconino NF and 122,856,697 cubic feet of biomass from the Kaibab NF would be a direct beneficial effect of alternative B. In alternative C, timber harvest of 245,343,350 cubic feet of biomass from the Coconino NF and 122,393,816 cubic feet of biomass from the Kaibab NF would be direct beneficial effects. In alternative D, timber harvest of 243,299,684 cubic feet of biomass from the Coconino NF and 122,856,697cubic feet of biomass from the Kaibab NF would be the direct beneficial effects. Alternative C would provide the most biomass on both forests (see table 51).

Table 51. Cubic feet of biomass (forest products) by alternative and forest

Forest	Alt. A	Alt. B	Alt. C	Alt. D
Coconino NF	0	243,302,331	245,343,350	243,299,684
Kaibab NF	0	122,856,697	122,393,816	122,856,697
Total		**366,159,029**	**367,737,165**	**366,156,380**

In alternative A, vegetation development (ingrowth and mortality) within current road rights-of-way would continue on the current trajectory. In alternatives B, C, and D, road decommissioning would allow ingrowth of forest vegetation once the road is decommissioned (approximately 2,712 acres).

In alternatives B, C, and D, constructing temporary roads would remove trees and forest vegetation within the road rights-of-way on approximately 735 acres (table 52). Opening decommissioned roads may remove trees and forest vegetation that has become established (within the road right-of-way since the road was last maintained) within approximately 816 acres. Road reconstruction consists of road improvement activities and road realignments activities. Road realignment of 10 miles of road would remove approximately 30 acres of trees and forest vegetation within the area being reconstructed. Thirty miles of road improvement would be expected to occur on small discreet areas and would be expected to remove about 100 acres of forest vegetation. The above listed effects cover the maximum range of management actions.

Table 52. Acres of ground disturbance from road actions in alternatives B, C, and D

Ground-disturbing Actions	Alt. B	Alt. C	Alt. D
Temporary road construction	735	735	735
Temporary opening of decommissioned roads	816	816	816
Road reconstruction	130	130	130

Aspen Fencing

In alternatives B, C, and D, aspen fencing would occur after mechanical and burning treatments and would have no effect to the vegetation. Leaving felled material on the ground for jackstrawing would forego the opportunity to use that material for wood products.

Springs and Channels

In alternatives B, C, and D, springs and ephemeral channels are inclusions within the mechanical and burn treatment areas. Any tree removal that occurs as part of the restoration of these areas would be part of the design for those mechanical treatments that occur around these areas, and the effects to the forest vegetation would be similar to the overall treatment. Fencing would have no effect to the vegetation. Bank recontouring and stabilization would occur along 39 miles of ephemeral channels. This activity would disturb existing forest vegetation. Up to 5 miles of willow reestablishment would occur where evidence indicates historic willow presence. This would create vegetation diversity and allow natural willow expansion into adjacent areas of suitable habitat. The above listed effects cover the maximum range of management actions.

Forest Plan Amendments

The following is a description of how forest plan amendments under this EIS would modify the forest plans' standards and guidelines and what the effects to the vegetation resource would be if the amendment did not occur.

Coconino NF

Amendment 1 in alternatives B and D: If the amendment did not occur, mechanical treatments would be limited to a maximum 9-inch d.b.h. in the 18 PACs, thereby restricting the treatment to a fuels reduction objective and reducing the ability to improve MSO habitat in terms of age class diversity and liberation of overtopped oak. Treatments within MSO habitat would continue to meet the intent of the MSO recovery plan, and the MSO habitat definition would not have an effect on the treatments themselves or their outcomes. Following existing forest plan language concerning MSO population and habitat monitoring or MSO habitat design would not have an effect on the treatments themselves or their outcomes.

Amendment 1 in alternative C: If the amendment did not occur, mechanical treatments would be limited to a maximum 9-inch d.b.h. in the 18 PACs. This would restrict the treatment to a fuels reduction objective and reduce the ability to improve MSO habitat in terms of age class diversity and liberation of overtopped oak. Without the use of prescribed fire in 56 MSO core areas, the opportunity to improve MSO habitat in terms of reducing litter/duff cover and stimulating regeneration and growth of native herbaceous vegetation would be eliminated.

Treatments within MSO habitat would continue to meet the intent of the MSO recovery plan, and the MSO habitat definition would not have an effect on the treatments themselves or their outcomes. Mechanical treatments within the 6,321 acres of target/threshold habitat would follow the denser 150 square feet basal area guidance, thereby reducing the ability to improve MSO nesting/roosting habitat in terms of sustainability, as indicated by high potential for density-related mortality and high bark beetle hazard rating, as well as reducing the ability to improve age class diversity and the liberation of overtopped oak. Following existing forest plan language concerning MSO population and habitat monitoring or MSO habitat design would not have an effect on the treatments themselves or their outcomes.

Amendment 2 in alternatives B, C, and D: If the amendment did not occur, the lack of clarifying language describing the relationship between nonforested areas (interspace) and natural openings across the landscape could result in interspace establishment being eliminated from the treatment design. The only features contributing to landscape openness would be existing natural openings. If that were to occur, it would inhibit the ability to meet desired conditions in terms of creating a mosaic of interspaces and tree groups of varying shapes and sizes, enhancing the representation of all age and size classes, sustaining old forest structure across the landscape, improving forest health, and enriching vegetation diversity and composition.

The plans lack explicit language for measuring canopy cover. Treatments within goshawk habitat would continue to meet the intent of the forest plans with regards to canopy cover, and the lack of explicit language for how or where it is measured would not have an effect on the treatments themselves or their outcomes. The 29,017 acres would be managed under the current forest plan guidelines, and desired conditions consistent with an open reference condition would not be met. Treatments within goshawk habitat would continue to meet the intent of the forest plan guidelines. Defining these terms is for clarification purposes and would not have an effect on the treatments themselves or their outcomes.

Amendment 3 in alternatives B, C, and D: If the amendment did not occur, it could potentially result in areas not being treated in order to attain a “no effect” determination. Without treatment, these areas would not move toward desired conditions in terms of creating a mosaic of interspaces and tree groups of varying shapes and sizes, enhancing the representation of all age and size classes, sustaining old forest structure across the landscape, improving forest health, and enriching vegetation diversity and composition.

Kaibab NF

Amendment 1 in alternatives B, C, and D: If the amendment did not occur, the lack of clarifying language describing the relationship between nonforested areas (interspace) and natural openings across the landscape could result in interspace establishment being eliminated from the treatment design. The only features contributing to landscape openness would be existing natural openings. If that were to occur, it would inhibit the ability to meet desired conditions in terms of creating a mosaic of interspaces and tree groups of varying shapes and sizes, enhancing the representation of all age and size classes, sustaining old forest structure across the landscape, improving forest health, and enriching vegetation diversity and composition.

The plans lack explicit language for measuring canopy cover. Treatments within goshawk habitat would continue to meet the intent of the forest plans with regards to canopy cover and the lack of explicit language for how or where it is measured would not have an effect on the treatments themselves or their outcomes. The 27,637 acres (alternatives B and D) or the 27,675 acres (alternative C) would be managed under current forest plan guidelines, and desired conditions consistent with an open reference condition would not be met. Treatments within goshawk habitat would continue to meet the intent of the forest plan guidelines. Defining these terms is for clarification purposes and would not have an effect on the treatments themselves or their outcomes.

Alternative 2 in alternatives B and D: If the amendment did not occur, treatments within MSO habitat would continue to meet the intent of the MSO recovery plan, and the MSO habitat definition would not have an effect on the treatments themselves or their outcomes. Managing for 10 percent threshold habitat within the Kaibab NF portion of the project area could result in habitat that is not capable of maintaining a population of MSOs and could not be sustained through time if designated as threshold habitat. Following existing forest plan language concerning MSO population and habitat monitoring or MSO habitat design would not have an effect on the treatments themselves or their outcomes.

Amendment 2 in alternative C: If the amendment did not occur, fire and mechanical treatments would not take place within the Garland Prairie RNA. The effect of no action within the RNA would include continued encroachment of existing interspace by ingrowth and tree crown expansion and no reestablishment of historic openings which would further reduce forage production and understory species diversity. This would result in declining forest health in terms of increased probability of density-related mortality, increased beetle hazard, continued forest conditions that encourage mistletoe spread and intensification, and decreased resilience under a warmer, drier climate.

Amendment 3 in alternative C: If the amendment did not occur, treatments within MSO habitat would continue to meet the intent of the MSO recovery plan and the MSO habitat definition would not have an effect on the treatments themselves or their outcomes. Managing for 10 percent threshold habitat within the Kaibab NF portion of the project area could result in habitat that is not capable of maintaining a population of MSOs and that could not be sustained through time if designated as threshold habitat. Mechanical treatments within the 2,090 acres of target/threshold habitat would follow the denser 150 square basal area guidance, thereby reducing the ability to improve MSO nesting/roosting habitat in terms of sustainability, as indicated by high potential for density-related mortality and high bark beetle hazard rating as well as reducing the ability to improve age class diversity and the liberation of overtopped oak. Following existing forest plan language concerning MSO population and habitat monitoring or MSO habitat design would not have an effect on the treatments themselves or their outcomes.

Cumulative Effects

For the cumulative effects analysis, the spatial context is the larger 988,764-acre analysis area. Cumulative effects are discussed in terms of wildfire and vegetation management activities that have occurred since 2001 and as changes in the existing condition due to present and foreseeable activities, including the effects of the alternative being discussed. The timeframe considered is approximately 10 years in the future at which time the majority of the actions proposed will have been completed and the vegetation response to these actions will have occurred.

Table 53 lists approximate acres of the various vegetation management, fuels treatment, and prescribed fire, as well as wildfires that have occurred within the project area from 2001 to 2010:

- Mechanical vegetation management activities have mainly consisted of tree thinning. This includes 50,940 acres with a fuels reduction emphasis, 14,950 acres with a ponderosa pine restoration emphasis, and 750 acres with an emphasis on improving forest structure, health, and growth. There has also been 12,560 acres of tree removal to restore ponderosa pine savannas and encroached grasslands, 2,650 acres of removal of dead, damaged, or dwarf mistletoe infected trees to improve forest health, 100 acres of tree removal to restore aspen inclusions, and 1,935 acres of habitat improvement treatments that reduced tree density within antelope travel corridors. Within the project area there has been 640 acres of tree and vegetation removal associated with powerline corridor management and protection.
- Fuels treatments that have been accomplished in association with the above listed mechanical treatments include 3,910 acres of mechanical fuels treatments (slash lopping, crushing, piling, and jackpot burning), 5,070 acres of machine piling and burning, and 59,640 acres of broadcast burning. The primary focus of these treatments was to rearrange and reduce activities generated fuels.
- Prescribed burns have been implemented on 47,970 acres to reduce natural fuels accumulations and reintroduce fire to fire-adapted ecosystems.
- Wildfires from 2001 to 2010 have burned on approximately 108,160 acres of the project area. Of these acres, it is estimated that the overall average burn severity to the vegetation was 20 percent high severity, 30 percent mixed severity, and 50 percent low severity. There is wide variability among these percentages from fire to fire.

Table 53. Approximate acres of vegetation management activities and wildfire within the project area from 2001 to 2010

Treatment	Treatment Type	Approximate Acres
Mechanical Vegetation Management	Thinning—Fuels Reduction Emphasis	50,940
	Thinning— Restoration Emphasis	14,950
	Thinning—Stand Improvement	750
	Savanna/Grassland Restoration	12,560
	Sanitation/Salvage	2,650
	Aspen Restoration	100
	Habitat Improvement	1,935
	Powerline Hazard Tree Removal and Right-of-Way	640
Total Mechanical		**84,525**
Fuels Treatments (With Mechanical)	Mechanical Fuels Treatment	3,910
	Pile and Burn	5,070
	Broadcast Burn	59,640
Total Fuels Treatments		**68,620**
Prescribed Burn (Burn Only)		**47,970**
Wildfire		**108,160**

Forest Structure and Diversity – Mosaic of Interspaces and Tree Groups of Varying Sizes and Shapes

The thinning with a restoration emphasis and savanna restoration treatments were designed to reestablish forest openings and attain a mosaic of interspaces and tree groups of varying sizes and shapes. All other treatments listed were incidental to this desired condition. Mixed-severity wildfires resulted in a mosaic of tree mortality and a pattern with indiscriminate interspaces and tree groups. The remaining treatments and low-severity wildfire resulted in some irregular tree spacing.

Forest Structure – All Age and Size Classes Represented

The main objective of thinning with a fuels reduction emphasis was to reduce canopy fuels and the potential for crown fire initiation. Generally, this type of treatment focused on removal of trees in the subordinate crown positions and retaining those trees in the dominate and codominate crown positions and any pre-settlement trees. This type of treatment resulted in a moderately open canopy, even-aged forest structure with very little age and size class diversity.

Thinning treatments with restoration objectives were very similar to the goshawk habitat and MSO restricted other habitat treatments proposed under this EIS and have resulted in similar diversity in age and size class.

Prescribed fire and mechanical fuels treatments associated with the above thinning treatments resulted in periodic tree mortality of seedling/sapling size trees and susceptible pre-settlement trees, further reducing age class diversity.

High- and mixed-severity wildfires caused large-scale mortality across all age and size classes resulting in a nonstocked or single age class representation. Wildfires that burned with a low severity and prescribed burn only treatments had similar effects to forest structure as the post-thinning prescribed fires.

Old Forest Structure Sustained Over Time Across the Landscape

Thinning treatments retained pre-settlement trees and the largest post-settlement trees. Sanitation treatments may have removed some old forest structure. Prescribed fire and low-severity wildfire resulted in periodic tree mortality of susceptible pre-settlement trees. Mixed- and high-severity wildfire killed a large proportion of the old forest structure. Powerline treatments removed any old forest structure that was a hazard to the powerline.

Forest Health

Thinning treatments resulted in forest density within the low to moderate density zones. This, in turn, had a beneficial effect of improved forest growth and reducing the potential for density and bark beetle related mortality. Thinning treatments also removed dwarf mistletoe infected trees, reducing the percent of trees infected as well as creating conditions that slowed or inhibited mistletoe spread. Prescribed fire and low-severity wildfire also led to localized reduction of forest density and dwarf mistletoe infection.

Thinning treatments reduced risks associated with dense forest conditions and improved resilience to the impacts of large-scale disturbance under drier and warmer conditions. Within-forest carbon stocks were reduced by the thinning. Some of the carbon removed has been sequestered for a time in the form of pallets and building materials. Mixed and high-severity wildfires released large amounts of carbon into the atmosphere and resulted in a carbon source as dead material continues to decay. This is especially prevalent in burned areas where the conifer forests have not regenerated.

The savanna/grassland restoration treatments implemented restored historic grasslands, savannas, and forest openings by removing ponderosa pine tree canopy that was shading out understory herbaceous vegetation. Thinning treatments with a restoration objective also restored historic forest openings.

Removing conifer competition with mid-story and understory oak as part of the thinning contributed to maintaining and improving oak growth and vigor. Mixed- and high-severity wildfire killed large oaks that were replaced by oak sprouts, thereby changing oak structure from old to young.

Aspen restoration treatments were very similar to the aspen treatments proposed under this project and have resulted in aspen regeneration and age class diversity.

Some of the fuels reduction thinning within pine-sage on the Tusayan district removed overtopping young pines and improved conditions for understory sage.

Cumulative Effects – Alternative A

Alternative A would not contribute to improving forest health or vegetation diversity and composition, or sustaining old forest structure over time or moving forest structure toward desired conditions.

Cumulative Effects – Alternatives B, C, and D

Alternative B restoration treatments would contribute an additional 509,195 acres toward improving forest health and vegetation diversity/composition, sustaining old forest structure over time and moving forest structure toward desired conditions.

Alternative C restoration treatments would contribute an additional 562,380 acres toward improving forest health and vegetation diversity/composition, sustaining old forest structure over time and moving forest structure toward desired conditions.

Alternative D restoration treatments would contribute an additional 489,029 acres toward improving forest health and vegetation diversity/composition, sustaining old forest structure over time and moving forest structure toward desired conditions.

Cumulative Effects – Present and Foreseeable Vegetation Management Activities

Table 54 lists approximate acres of the various vegetation management, fuels treatment, and prescribed fire that are ongoing (as of 2011) or are foreseeable within the project area. The effects of the thinning with restoration emphasis, savanna/grassland restoration, aspen restoration, as well as prescribed fire are similar to what has been described with the proposed treatments for this EIS. The effects of the thinning with a fuels reduction emphasis will be similar to those that occurred from 2001 to 2010 as discussed above. The salvage involves the removal of down trees as a result of the 2010 tornado and has no effect to forest structure or diversity. The maintenance of powerline corridors will continue as needed and will remove any vegetation that is a hazard to the line.

Table 54. Approximate acres of present and foreseeable vegetation management activities within the project area

Treatment	Treatment Type	Approximate Acres
Mechanical Vegetation Management	Thinning—Fuels Reduction Emphasis	6,670
	Thinning—Restoration Emphasis*	80,940
	Thinning—Stand Improvement	0
	Savanna/Grassland Restoration	11,130
	Sanitation/Salvage	4,290
	Aspen Restoration	5,130
	Habitat Improvement	0
	Powerline Hazard Tree Removal and Right-of-Way	500
Total Mechanical		**108,660**

Treatment	Treatment Type	Approximate Acres
Fuels Treatments (With Mechanical)	Mechanical Fuels Treatment	0
	Pile and Burn	0
	Broadcast Burn	102,470
Total Fuels Treatments		**102,470**
Prescribed Burn (Burn Only)		**5,950**

*Vegetation cumulative effects analysis does include the foreseeable (2013) Flagstaff watershed protection project even though little information is available on treatments. This analysis assumes both mechanical and prescribed fire treatments would occur.

Fire Ecology

Only a summary of the fire ecology analysis is presented here and the report is incorporated by reference. See the fire ecology specialist report (Lata 2013) for the complete analysis. Fire behavior was analyzed at several scales including the project scale (593,211-acre treatment area), RU, subunit, and vegetation type/habitat type in order to provide a thorough analysis of specific fire effects to different areas. Using various scales of analysis provides site-specific information on existing risks and threats to resources and addresses the comments and recommendations received throughout the scoping process. FRCC was analyzed at the project area scale for ponderosa pine and grasslands as they make up 90 percent of the project area. See the specialist report for the complete discussion on analysis methodology.

The following analysis question was used to evaluate movement toward desired conditions by alternative:

> **Analysis Question 1:** Would/how would proposed management actions move the area toward the project's desired condition of having a resilient forest by reducing the potential for undesirable fire behavior and effects? Metrics used to evaluate differences between alternatives include:

- **Type of fire (surface or crown):** Acres (quantitative measure) of each potential fire type following proposed treatments were evaluated.
- **Canopy characteristics—canopy base height, canopy bulk density, and canopy cover** (quantitative measures used in fire modeling): These are canopy characteristics that are important for modeling fire.
- **Surface fuel loading for the fire and emissions modeling includes CWD>3″, litter, and duff** (quantitative measure): Used to qualitatively evaluate fire effects.
- **FRCC** (qualitative measure): FRCC was determined for ponderosa pine and grasslands which make up the largest vegetation types within the treatment area to determine the relative departure of those ecosystems from reference conditions before and following treatments.

Affected Environment

Existing and desired conditions for fire behavior and FRCC are addressed in the "Fire Ecology" section in chapter 1. Most existing condition information is not repeated here.

Fire Behavior at the Landscape Scale

Fire type was modeled for conditions similar to those under which the Schultz Fire burned in 2010. These were not extreme in terms of fuel moisture, temperature (77 degrees Fahrenheit), or relative humidity (14 percent), though fuels were dry and it was windy (steady at 25 mph). These conditions are common in June across the project area.

Fire Behavior by Restoration Unit (RU)

RU 1

RU 1 is currently the most at risk of all the RUs in regards to crown fire and its effects. Approximately 42 percent of the RU has crown fire potential, of which 31 percent would be active crown fire. Values at risk in or adjacent to RU 1 include: Lake Mary, a source watershed for Flagstaff and a popular recreation site for locals and visitors to the area (subunit 1-1); Pulliam Airport, the commercial airport that serves Flagstaff and surrounding communities (subunit 1-1); eastern and southern portions of the city of Flagstaff; the Perkins Telescope (subunit 1-1); numerous MSO PACs (more than any other RU), and Walnut Canyon National

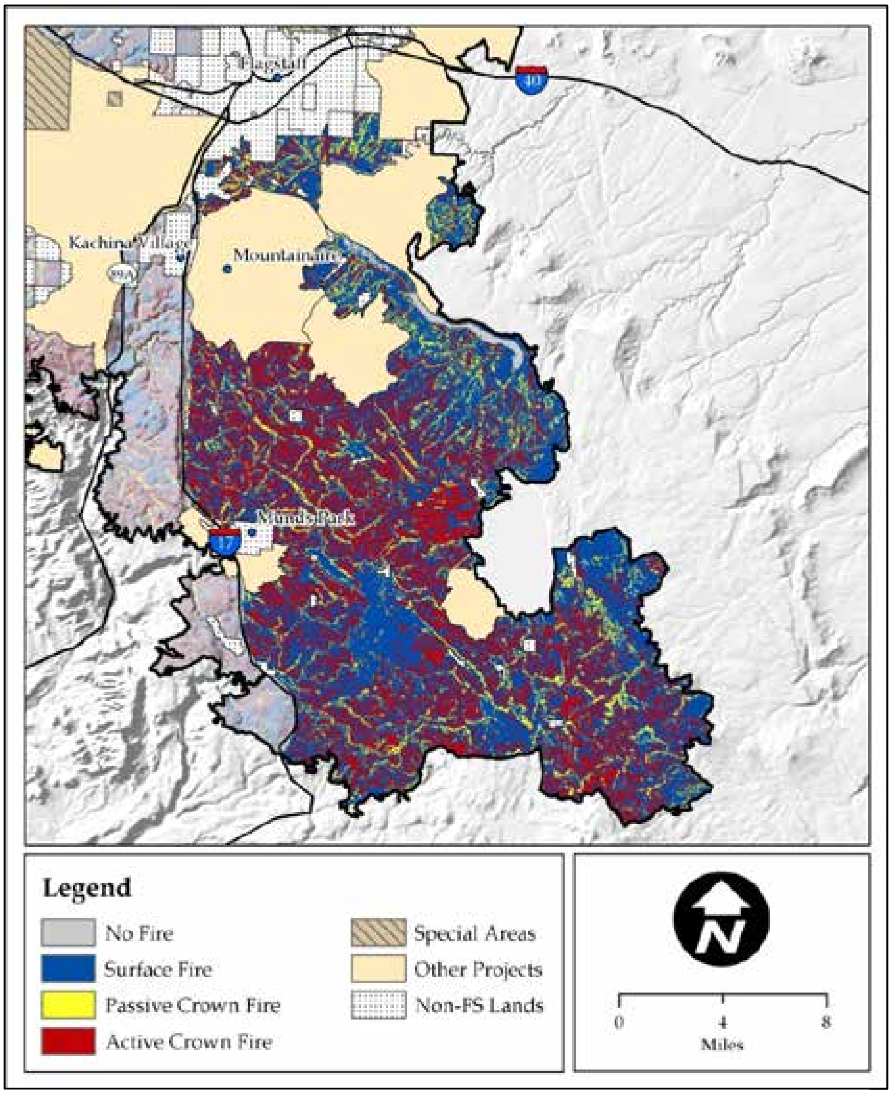


Figure 38. Existing fire potential in RU 1

Monument (subunit 1-1). Figure 38 displays locations of no fire, surface fire, and active/passive crown fire. "No fire" includes areas that could not burn under conditions modeled because of sparse vegetation (such as on some cinder soils) or no vegetation (water, rock, etc.).

RU 3

RU 3 has the second greatest potential for undesirable fire effects and behavior. Approximately 39 percent of RU 3 has crown fire potential, of which 30 percent would be active crown fire. Winds on the Mogollon Rim are generally out of the southwest; therefore, values at risk in this RU include: Interstate 17 and Interstate 40, as well as the communities of Flagstaff, Munds Park, Williams, Belmont, Kachina Village, Parks, and Sycamore and Oak Creek Canyon.

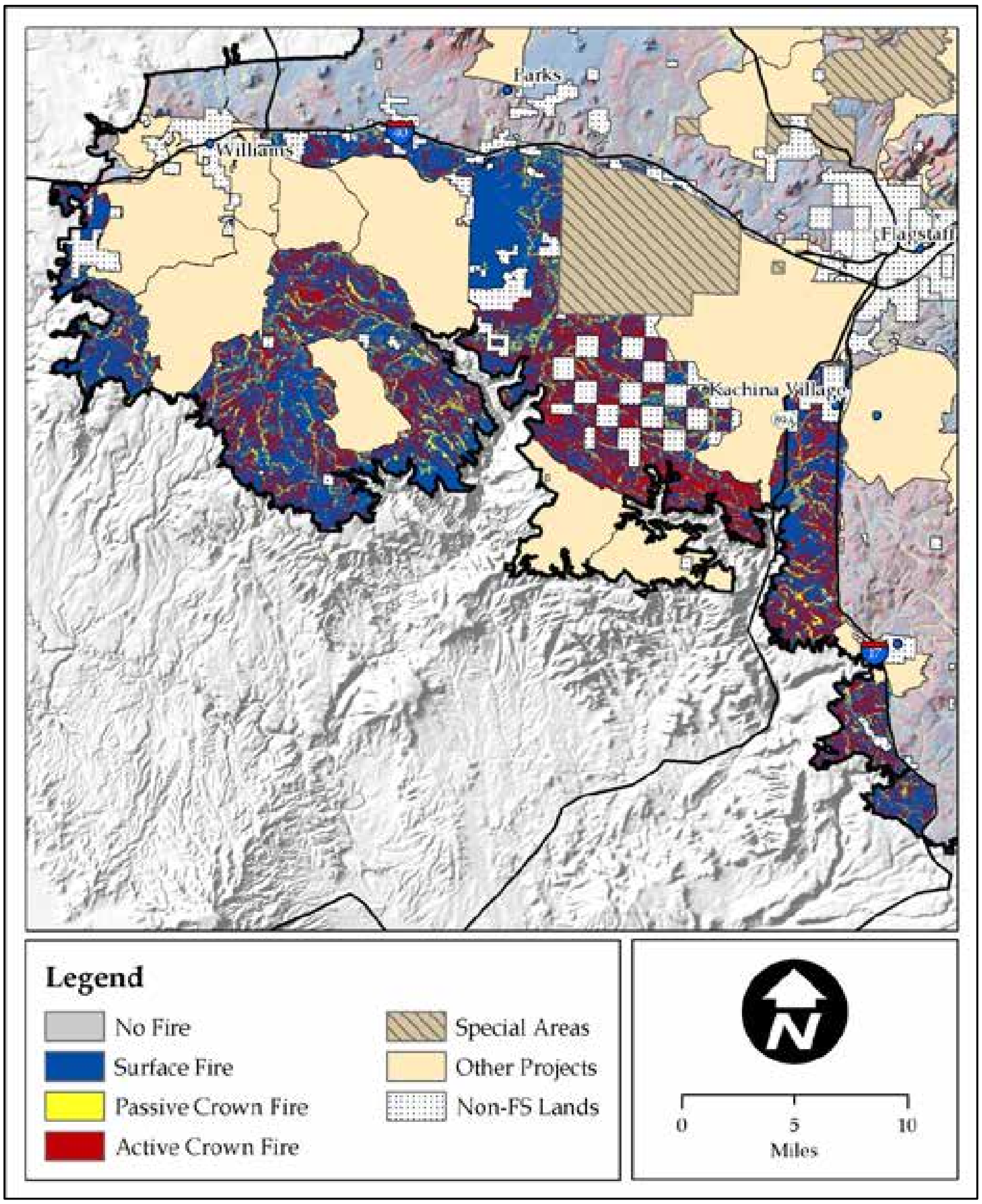


Figure 39. Existing fire potential in RU 3

RU 4

RU 4 has a 32 percent potential for crown fire, of which 25 percent would be active crown fire. RU 4 is located west and north of Flagstaff, and north of Williams and Interstate 40. Wildfire in RU 4 has potential to affect the communities of Flagstaff, Williams, Parks, and Belmont, though the prevailing winds would draw fire away from these communities. There is also potential to impact the Fort Valley Experimental Station northwest of Flagstaff.

Over the last 20 years, RU 4 has been impacted by several large fires, including the Hockderffer (2004, 16,000 acres) and Pumpkin (2000, 8,700 acres) Fires. Areas of potential active crown fire currently exist adjacent to heavy fuel loading in mixed conifer on Kendrick and Sitgreaves Mountains, and the San Francisco Peaks.

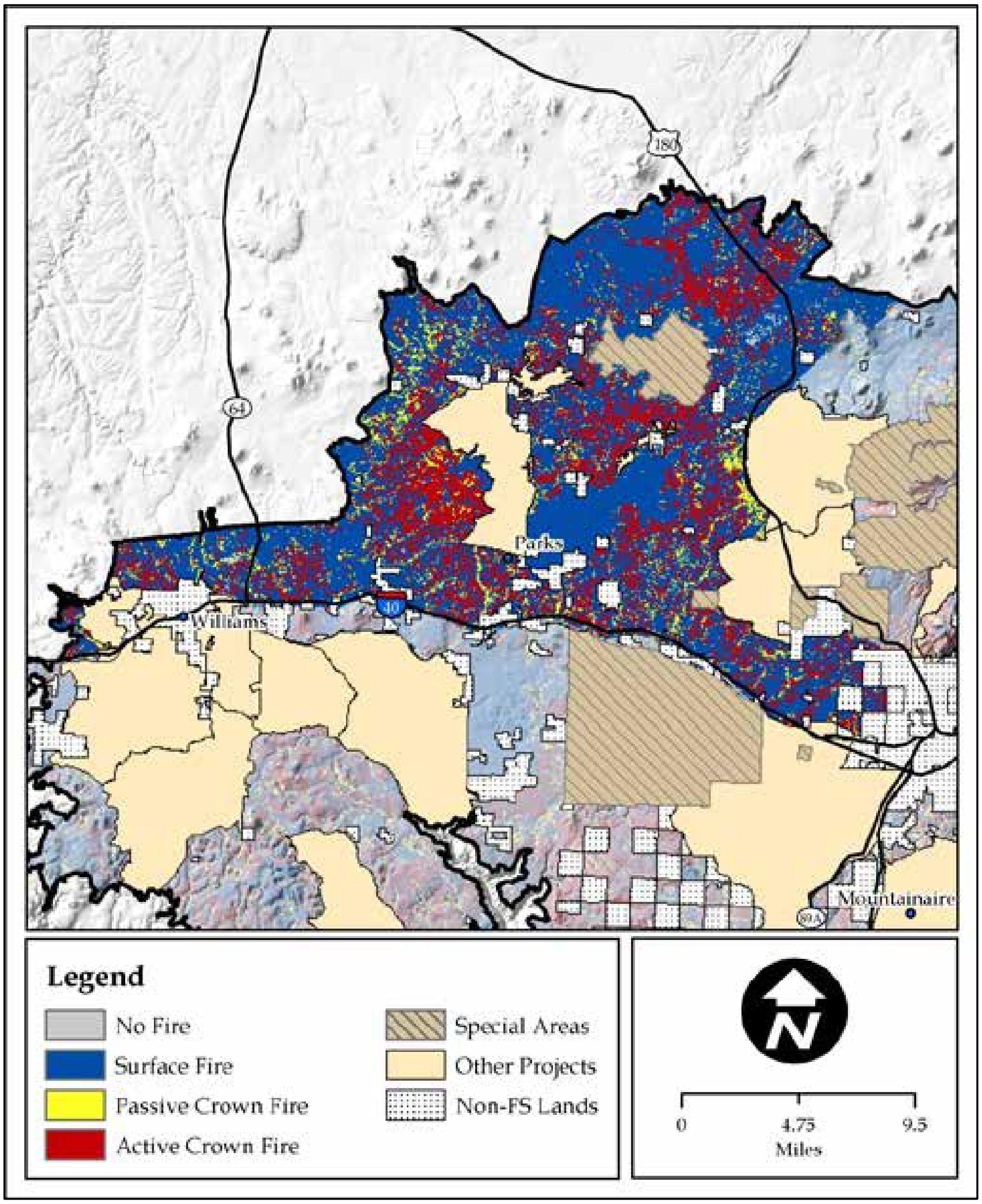


Figure 40. Existing fire potential in RU 4

RU 5

RU 5 has 22 percent potential for crown fire, of which over half would be active crown fire. This RU includes acres burned in the Schultz Fire (2010, 17,000 acres) and acres burned in the Radio Fire (1977, 2,600 acres). The Radio Fire burned area is mostly on Mount Elden which is immediately upslope and adjacent to northern Flagstaff. Housing developments (including Doney Park) and the city of Flagstaff would be adjacent and mostly downslope from any fire occurring in this RU.

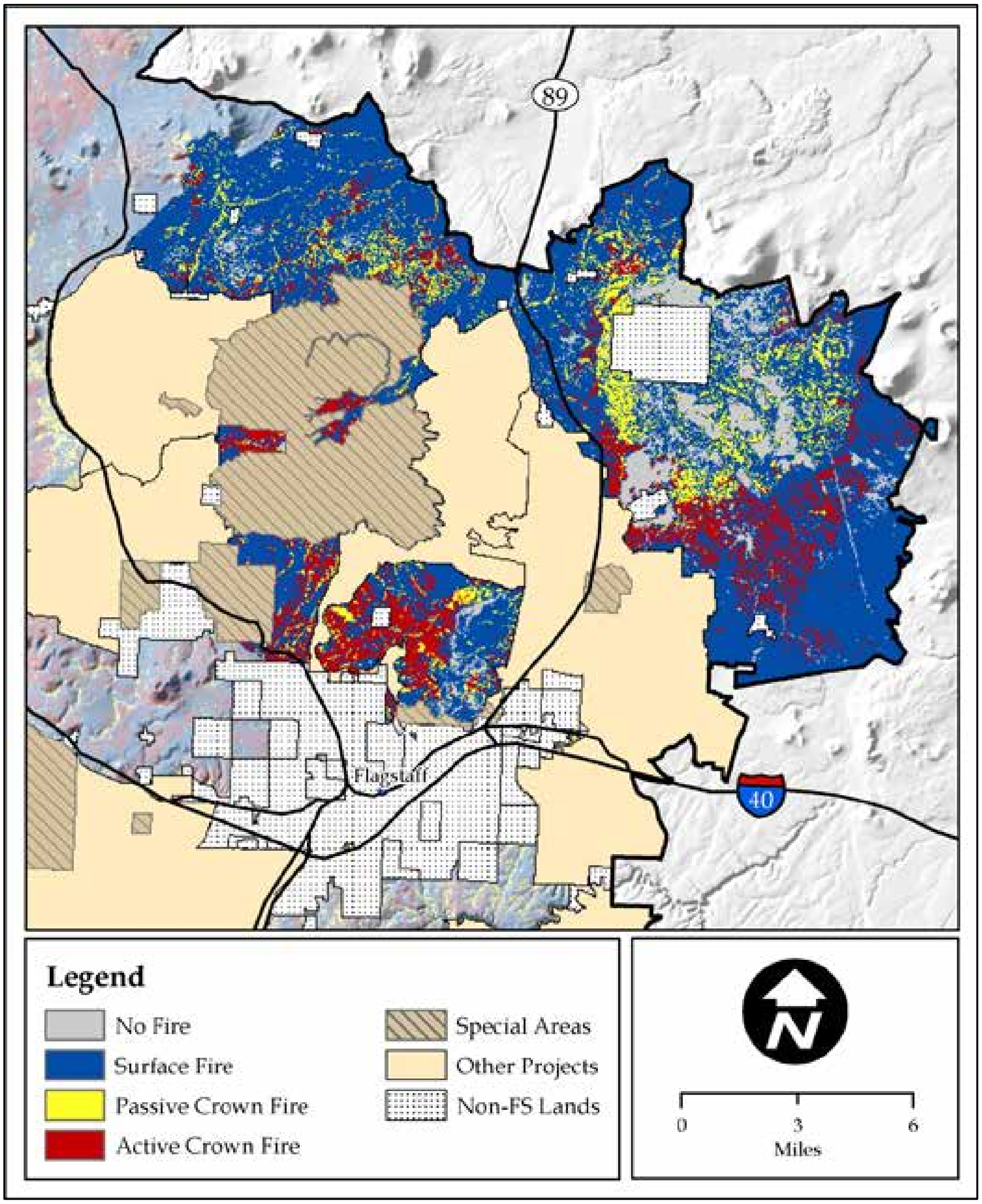


Figure 41. Existing fire potential in RU 5

RU 6

RU 6 has a 19 percent potential for crown fire. Of this percent, over 50 percent would be active crown fire. RU 6 is entirely within the Tusayan Ranger District (Kaibab NF). It is located in close proximity to the town of Tusayan and located immediately south of, and adjacent to, Grand Canyon National Park. RU 6 is the driest of all the RUs. Over half of the RU has been affected by wildfire in the last 10 years. Potential fire behavior in pinyon-juniper which is adjacent to the town of Tusayan is a concern.

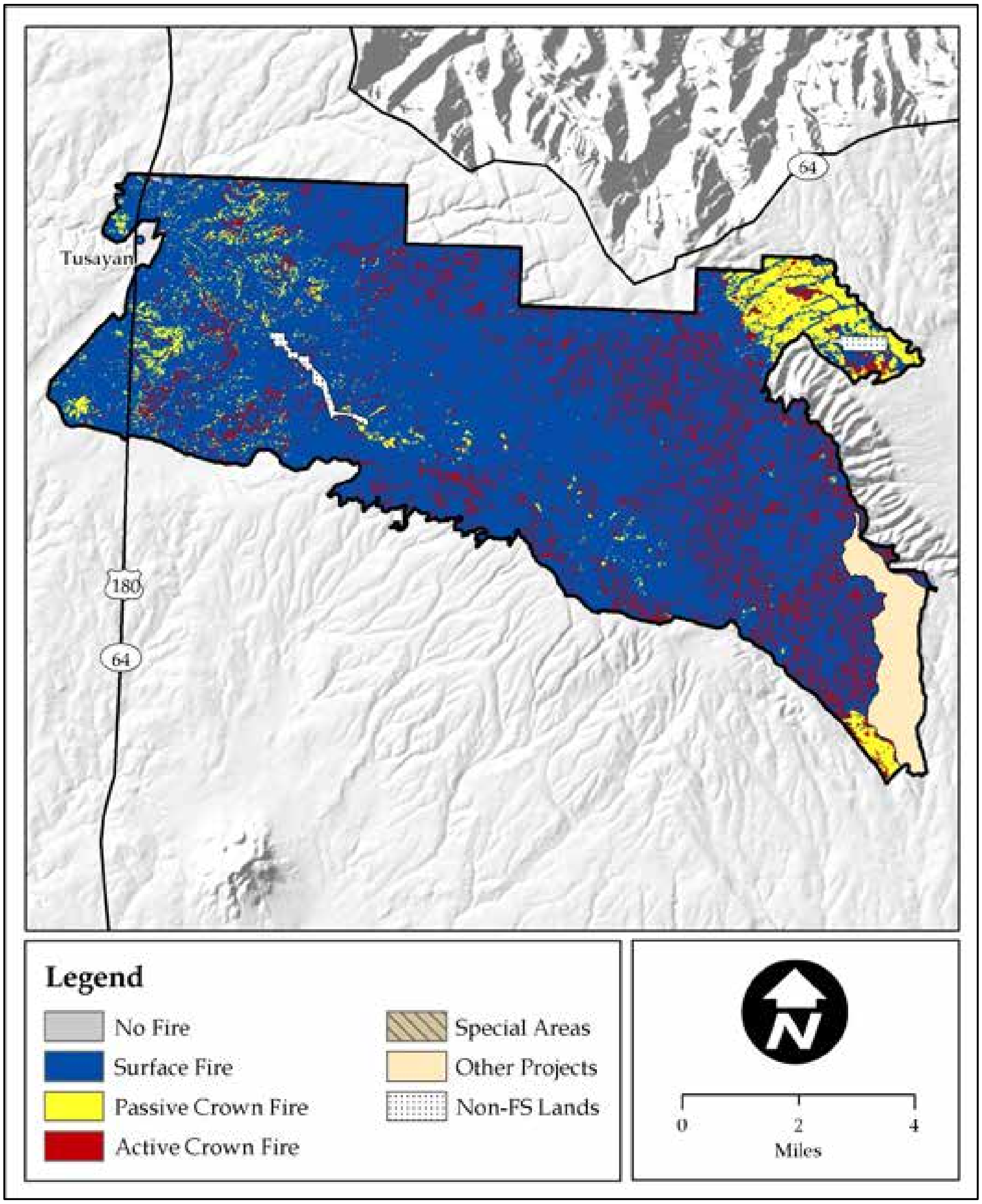


Figure 42. Existing fire potential in RU 6

Canopy Characteristics and Surface Fuels Affecting Fire Behavior

The existing and desired condition for canopy characteristics (canopy base heights and canopy bulk density) and surface fuels (CWD greater than 3 inches, litter, and duff) are presented in chapter 1.

Fire Regime Condition Class (FRCC)

The existing and desired conditions for FRCC are presented in chapter 1.

Environmental Consequences

Throughout this section, changes directly attributable to proposed actions—such as thinning or prescribed fire—are direct effects. These include changes to canopy bulk density, canopy base height, consumption of surface fuel, etc. Changes to the potential behavior and effects of wildfires that result from the direct effects are considered indirect effects.

Alternative A – Direct and Indirect Effects

Fire Behavior at the Landscape Scale

At the landscape scale, 34 percent of ponderosa pine and 9 percent of grasslands would have the potential for high-severity effects from crown fire. The potential for crown fire exceeds the desired condition in ponderosa pine by 24 percent and 6 percent in grasslands. Modeled fire type shows the potential for multiple, large (greater than 1,000 acres), high-severity fires across the landscape, with the actual extents dependent on ignition location and environmental conditions. As canopies close up, surface fuel loading would also continue to increase. In the long term (2050), more area would be subject to high severity surface fire. The changes in canopy fuels would have detrimental effects on understory vegetation and would increasingly suppress surface vegetation (forbs, grasses, and shrubs). The combination of abundant and contiguous canopy fuels, the lack of understory vegetation, and an already high and increasing surface fuel load, would combine to increase the potential for high-severity fire, maintaining the area in a FRCC of 3 into the foreseeable future.

Fire Behavior at the RU Scale

In 2020, no RUs would meet desired conditions for fire behavior, ranging from 42 percent (RU 1) to 14 percent (RU 6) (table 55). In RU 1, there is potential for 60,000 acres of ponderosa pine to burn with high severity (potential crown fire combined with the potential for high severity surface fire), a subset of which would convert to a nonforested vegetation type (Savage and Mast 2005). Should wildfire burn though the Lake Mary watershed, the second order fire effects (debris flows and flooding with sediment-laden water) could jeopardize the water supply (from the lakes) as well as, at least temporarily, require the closure of recreation sites.

Table 55. Modeled fire type for alternative A (2020) by restoration unit* in acres and percent of treatment area

RU	Surface	Passive	Active	No Fire
RU 1	90,633 (58%)	18,251 (12%)	46,463 (30%)	957 (0.6%)
RU 3	92,532 (62%)	14,219 (9%)	42,082 (28%)	886 (0.6%)
RU 4	111,840 (68%)	11,850 (7%)	41,285 (25%)	633 (0.4%)
RU 5	52,931 (70%)	7,265 (10%)	10,100 (13%)	5,800 (6.1%)
RU 6	37,121 (85%)	2,766 (6%)	3,600 (8%)	42 (0.1%)
Total	**385,056 (65%)**	**54,351 (9%)**	**143,530 (24%)**	**8,319 (1.4%)**

* "No fire" includes acres on which there were insufficient fuels to carry fire, including water, rock, cinders, areas of sparse vegetation, etc.

In RU 3, multiple drainages line up with the prevailing winds and have the potential to draw fire toward communities such as Pumphouse Wash (Kachina Village) and Munds Canyon (Munds Park). Adjacency concerns for fire behavior include a number of communities as well as Oak Creek and Sycamore Canyons. Second order fire effects (flooding, debris flows, deposition, erosion, etc.) would have potential to impact Oak Creek and Sycamore Canyons, with the specific locations depending on the slope, proximity, and size of high-severity fire. Overall, with no treatment, there is potential for over 56,000 acres of crown fire (37 percent of the RU), of which over 42,000 (28 percent of the RU) would be active crown fire.

No action in RU 4 would have the potential to affect the communities of Flagstaff, Williams, Parks, and Belmont, though the prevailing winds would tend to blow fire away from most of the populations in Williams, Parks, and Belmont. There is also potential to impact the Fort Valley Experimental Station northwest of Flagstaff. Overall, with no treatment, there is potential for over 53,000 acres of crown fire (32 percent of the RU), of which over 41,000 (25 percent of the RU) would be active crown fire.

The northeastern area of RU 5 has scattered cinder cones and cinder areas which support only sparse vegetation. In these areas, active crown fire is less likely because of decreased potential for high intensity surface fire and decreased canopy fuel continuity. Overall, with no treatment, there is potential for over 17,000 acres of crown fire (23 percent of the RU), of which over 10,000 (13 percent of the RU) would be active crown fire.

Active crown fire in RU6 would mostly be dispersed, with only a few areas of contiguous crown fire. Overall, with no treatment, there would be potential for over 6,000 acres of crown fire (15 percent of the RU), of which over 3,000 (13 percent of the RU) would be active crown fire.

Canopy Characteristics and Surface Fuels Affecting Fire Behavior and Effects

Potential changes to canopy base height and crown bulk density were modeled for the short (2020) and long term (2050) (table 56). Under this alternative, canopy base height and crown bulk density slowly move toward desirable conditions, as a result of the lower branches becoming shaded out by increasing canopy cover. Increasing canopy cover, combined with the other canopy characteristics at or below desired conditions, would continue to make undesirable fire behavior and effects more likely.

Table 56. Alternative A canopy characteristics 2010 to 2050

Year	Canopy Base Height (feet)	Desired Condition (feet)	Canopy Bulk Density (kilograms per square meter)	Desired Condition (kilograms per square meter)	Canopy Cover (percent)
2010	14.86	18	0.061	0.05	66
2020	16.63	18	0.061	0.05	68
2050	22.22	18	0.059	0.05	72

Total surface fuel loading (CWD greater than 3 inches, litter, and duff) as modeled over 40 years shows a steady increase from approximately 16 to 22 tons per acre. There would be approximately 18,000 acres with surface fuel loading greater than 20 tons per acre (desired condition). These types of fuel loadings could produce undesirable fire effects, including large quantities of emissions. Areas that would have the highest surface fuel loading are often associated with MSO PACs including core areas. RUs 1 and 3 would have the highest surface fuel loading.

Fire Regime Condition Class (FRCC)

Under alternative A (table 57), fire regime/condition class would deteriorate and, by 2050, FRCC 3 acres in ponderosa pine would increase by 13 percent (over 65,000 acres) and FRCC 3 acres in grasslands would increase by 5 percent (almost 3,000 acres).

Table 57. Alternative A FRCC 2010 to 2050 in acres and percent

Vegetation Type	Condition Class	2010	2020	2050
Ponderosa Pine	1	70,680 (14%)	55,534 (11%)	5,049 (1%)
	2	136,311 (27%)	95,923 (19%)	136,311 (27%)
	3	297,866 (59%)	353,400 (70%)	363,497 (72%)
Grasslands	1	10,097 (18%)	6,731 (12%)	1,683 (3%)
	2	40,389 (72%)	42,632 (76%)	45,998 (82%)
	3	5,610 (10%)	6,731 (12%)	8,414 (15%)

Alternatives B, C, and D

The environmental consequences are based on the modeling assumption that one mechanical treatment and two prescribed burns would occur between 2012 and 2019. From 2020 to 2050, no wildfires or additional treatments of any kind were modeled. The effects are based on applying the design features and mitigation displayed in the “Fire” section of appendix C.

Effects Common to All Alternatives

- In the short term (up to 10 years), first entry burns (burns which are the first time fire occurs in an area that has missed 10 to 20 years of fire cycles) would: (1) effectively raise the canopy base height, decrease canopy bulk density, and decrease the likelihood of crown fire; (2) consume a large portion of accumulated litter and duff, along with the majority of dead/down woody fuels less than 3 inches in diameter; and (3) thin out some small trees (particularly seedlings), maintaining a mosaic of groups and interspaces. In areas where fire has been excluded for many decades, a single prescribed fire would be inadequate to reduce fuels (Lynch et al. 2000).
- In the long term, second entry burns are those burns which occur within 2 to 5 years of a first entry burn. For second entry burns, fuel loads would be significantly lower than in first entry burns, producing much less smoke and having lower potential for crown fire or high-severity fire.
- As thinning and first entry burns were completed, burn windows would expand for larger areas so more burning could occur when ventilation was good. The ability to manage unplanned ignitions would expand as 4FRI (and other projects) is implemented.
- Throughout the life of this project, it would be likely that some large and/or old trees would be damaged or killed by prescribed fire as over 30,000 to 50,000 acres of prescribed fire would occur each year. Reducing accumulations of fuel in the vicinity of large and/or old trees is best accomplished by a combination of mechanical and prescribed fire treatments, with the specific need being site specific. However, the damage or mortality to these trees would be mitigated (see “Fire Design Features and Mitigation” in appendix C of the DEIS).
- Potential adaptive management actions for transportation, springs, and roads were reviewed. None of the adaptive actions would result in additional effects that are not already disclosed or addressed in alternatives B, C, and D.

Fire Behavior at the Landscape Scale

Table 58 displays post-treatment fire behavior at the landscape scale for alternatives B, C, and D. In alternative B, the potential for crown fire at the landscape (treatment area) scale would be reduced from 34 percent to 5 percent. Alternative C best reduces the crown fire potential to 4 percent. Alternative D reduces crown fire potential the least (7 percent). See the specialist report which provides environmental consequences by vegetation type and restoration subunit. All action alternatives would meet the desired condition of having crown fire potential on 10 percent or less of the landscape.

Table 58. Alternatives B, C, and D landscape scale (treatment area) fire behavior

Modeled Fire Behavior (Percent of Treatment Area*)	Existing Condition	Alt. B (2020)	Alt. C (2020)	Alt. D (2020)
Surface fire	64	94	94	92
Passive crown fire	9	3	3	4
Active crown fire	25	2	1	3

* Total percentages do not include acres that would not support fire. These acres include area where there were insufficient fuels to carry fire, including water, rock, cinders, areas of sparse vegetation, etc.

Fire Behavior at the RU Scale

At the RU scale, the post-treatment potential for crown fire in alternative B would range from 2 to 8 percent and from 2 to 7 percent in alternatives C and D. Alternatives B and C would meet the purpose and need by moving the project area toward desired conditions of having 10 percent or less crown fire potential. Alternative D meets desired conditions for all RUs except RU 1. Approximately 12 percent of the acres in RU 1 would remain at risk of crown fire.

RU 1

Only alternatives B and C would meet fire behavior desired conditions. Crown fire potential would be reduced to 8 percent in alternative B and 7 percent in alternative C. Potential fire behavior would decrease downslope from the mixed conifer on Mormon Mountain, as well as the city of Flagstaff to the northwest. In alternatives B and C, over 60 percent of active crown fire potential would occur in MSO protected habitat. In alternative D, total crown fire potential would be 12 percent, exceeding desired conditions. Within RU 1, MSO protected habitat would account for over 92 percent of all active crown fire potential.

RU 3

Alternatives B, C, and D would meet fire behavior desired conditions by reducing crown fire potential to 5 percent of the treatment area for alternatives B and C (less than 8,800 acres), and 6 percent for alternative D (9,373 acres). Of the 5 percent, 1 percent would be active crown fire for B and C (less than 2,200 acres), and 2 percent for D. There would still be potential for active crown fire in PACs in Kelly Canyon and Pumphouse Wash, including potential for some active and passive crown fire on slopes greater than 30 and 40 percent. Outside of MSO PACs, there would be some contiguous areas of both passive and active crown fire. However, the majority of potential crown fire would be scattered passive crown fire.

RU 4

Alternatives B, C, and D would meet fire behavior desired conditions. In alternative B, RU 4 would have the potential for 3 percent crown fire (4,585 acres) and alternative C would have the potential for 2 percent (3,505 acres) crown fire. Alternative D would result in the most (5 percent) crown fire potential (7, 148 acres). All alternatives would have the potential for approximately 1 percent active crown fire.

Most of the potential crown fire in RU 4 would be in scattered patches, with few areas of contiguous active crown fire greater than about 15 acres, mostly in areas classified as grasslands or other nonpine vegetation. References to crown fire in grasslands here refer to crown fire in trees growing in the grasslands. There would be larger contiguous acreages of passive crown fire in goshawk PFAs and areas of lower intensity treatments, and some prescribed fire only treatments.

RU 5

Alternatives B, C, and D would meet fire behavior desired conditions. In alternative B, there would be 2 percent crown fire potential, and in alternative D, 4 percent. This would be reduced in alternative C to 2 percent. For all alternatives, the percent of potential active crown fire would be 1 percent or less. There are many areas, some larger than 500 acres, in the north and eastern areas of this RU that are cinder substrate. In these areas, active crown fire would be less likely because of decreased potential for high intensity surface fire.

RU 6

Alternatives B, C, and D would meet fire behavior desired conditions. In alternatives B and C, RU 6 would have 4 percent (2,204) acres with crown fire potential. Of this, 107 acres (less than 1 percent) would have the potential for active crown fire. In alternative D, the potential for crown fire increases to 5 percent. In all alternatives, acres with crown fire potential would occur in nest areas/PFA/dPFA (dispersal post-fledgling area) habitats and the potential for passive crown fire would be widely dispersed with concentrations in areas with components of juniper and oak, particularly on the northeastern and southeastern corners.

Canopy Characteristics and Surface Fuels Affecting Fire Behavior and Effects

Table 59 displays that the canopy characteristics in alternatives B, C, and D would move toward desired conditions immediately post treatment (2020). Alternatives B and C would meet desired conditions in both the short (2020) and long (2050) term when compared to the existing condition (2010). In the long term (2050), canopy bulk density (when averaged across the landscape) in alternative D meets desired conditions. However, when analyzed by desired openness (see the canopy cover column in table 59), canopy bulk density would exceed desired conditions on approximately 28,000 acres resulting in a high potential for crown fire.

Table 59. Alternatives B–D canopy characteristics for ponderosa pine from 2010 to 2050

Alt.	Canopy Base Height (feet)				Canopy Bulk Density (kg/m3)				Canopy Cover (percent)		
	2010	2020	2050	Desired Condition	2010	2020	2050	Desired Condition			
B	14.84	24.73	26.67	18	0.061	0.034	0.040	<0.05	66	55	63
C	14.86	24.71	26.65	18	0.061	0.034	0.040	<0.05	66	55	63
D	14.84	22.79	25.18	18	0.061	0.037	0.043	<0.05	66	58	65

Surface Fuel Loading (CWD Greater Than 3 Inches, Litter, and Duff)

In alternative B, post-treatment surface fuels would be reduced to recommended levels over most of the treatment area (5 to 20 tons per acre). The exceptions are mostly in RU 1 in MSO PACs where there would be surface fuel loadings greater than 20 tons per acre (table 60).

In alternative C, fuel loading would be decreased below 20 tons per acre in most of the treatment areas (table 60). There would be approximately 809 acres with surface fuel loading greater than 20 tons per acre occurring mostly in RU 3 in MSO PACs, a few areas in RU 4, and two areas in RU 5 (see figure 57 in the specialist report). In this alternative and in the immediate short term (up to 2 years post treatment), CWD greater than 3 inches would range from 2.46 to 2.96 tons per acre—below forest plan desired conditions. In the long term (2 plus years post treatment), modeling for this project and research (Waltz et al. 2003) suggest that it would be just a year or 2 before CWD levels once again meet desired conditions. In alternatives B and D, with no maintenance treatments after 2020, CWD greater than 3 inches would exceed current forest plan guidelines by 2050. When considered by desired openness (see the canopy cover column in table 59), both alternatives B and C would meet the recommended tons per acre of surface fuel loading.

In alternative D, all treated areas would remain below 20 tons per acre (meet desired conditions) when considered by desired openness (table 60). However, when considered at the stand level, there would be approximately 3,357 acres with surface fuel loading greater than 20 tons per acre in both the short term (2020) and long term (2050) mostly in MSO PACs or goshawk PFAs in RU 1 and RU 3 where no prescribed fire treatments would occur.

Table 60. Alternative B–D surface fuel loadings in ponderosa pine from 2010 to 2050

Alternative	CWD >3"			Litter			Duff		
	2010	2020	2050	2010	2020	2050	2010	2020	2050
B	4.44	3.46	7.01	3.97	2.48	4.22	3.76	3.42	3.97
C	4.46	2.93	6.45	3.97	2.12	3.22	3.77	3.42	3.94
D	4.44	5.97	8.80	3.97	3.75	4.49	3.76	3.87	4.50

FRCC

Table 61 compares the existing FRCC to expected changes by alternative. In ponderosa pine in the short term (2020), all action alternatives would move toward desired conditions with alternative C moving the most acres out of FRCC 3 (33 percent reduction). In the long term (2050), the percentage of ponderosa pine in FRCC 3 would increase in all alternatives with alternative D most closely resembling the existing condition as approximately 50 percent of the landscape would revert back to FRCC 3.

In grasslands, only alternative C would move toward desired conditions in both the short (2020) and long (2050) term. Alternative D would exceed desired conditions in both the short and long term.

Table 61. Alternatives B, C, and D FRCC in 2020 and 2050

Vegetation Type	FRCC	Existing Condition (2010)	Percent Change in FRCC by Alternative and Year					
			Alt. B		Alt. C		Alt. D	
			2020	2050	2020	2050	2020	2050
Ponderosa Pine	FRCC 1	14	18	15	19	16	8	5
	FRCC 2	27	78	49	81	51	82	45
	FRCC 3	59	4	36	0	33	10	50
Grasslands	FRCC 1	18	15	10	31	35	15	5
	FRCC 2	72	77	80	66	60	74	80
	FRCC 3	10	8	10	3	5	11	15

Other Restoration Treatments (Springs, Streams, Roads)

Streams and springs would not be expected to have much effect on fire behavior or effects in the short term. In the long term, restored hydrology, particularly in springs, may result in increased surface fuel loading near springs, allowing wildfire or prescribed fire to creep closer to the water source than is generally possible now. Forest plan direction includes using prescribed fire to manage fuels in riparian areas.

Many wildfires that have been started by humans begin in proximity to roads. The alternatives may result in fewer human-started wildfires. The more heavily used roads may have functioned as firebreaks in the past. Once decommissioned, surface fuel loadings would eventually grow back, allowing fire to burn across the area. During implementation of the mechanical treatments, temporary roads constructed for access (517 miles) would be available for access to burn units, and/or to be used as fire lines for prescribed fires.

Forest Plan Amendments

Alternative B

Alternative B Amendment 1 (Coconino NF): If amendment 1 is implemented, the resulting decreases in canopy base height, canopy bulk density, and canopy cover would have the indirect effect of slightly decreasing crown fire potential for the 18 MSO PACs that would receive mechanical treatments. An additional indirect effect would be to increase the ability of fire managers to implement prescribed fire within PACs because of decreased potential fire behavior. If amendment 1 is not implemented on the Coconino NF, these 18 PACs (approximately 10,700 acres) would retain the current forest structure that places them at high risk of high-severity fire. Potential fire behavior would make it difficult to implement prescribed fire because of narrow burn windows (weather and fuel conditions that would produce the desired fire effects and behavior). If prescribed fires were implemented on acres adjacent to PACs, it would be more likely that some fire lines would need to be created to avoid burning in the PAC, producing ground disturbance that would be less likely under the proposed amendment. There would be little effect on emissions, except for a slight decrease in potential emissions in the event of wildfire following mechanical treatments within the PACs.

Alternative B Amendment 2 (Coconino NF): If amendment 2 is implemented, it would allow 29,017 acres to be managed for an open reference condition. An indirect effect of managing for open conditions would be to have little potential for active crown fire, moving these acres toward desired conditions. Open conditions would, in the long run, produce fewer emissions because of less litter and debris from trees and the greater herbaceous component to surface fuels. If amendment 2 is not implemented on the Coconino NF, some treatments could be implemented, but these acres would not move as far toward desired conditions as they would be with the amendment.

Alternative B Amendment 3 (Coconino NF): If amendment 3 is implemented, it would allow fire to be used to meet objectives if it was determined to be the best tool. Additionally, it would allow all significant, or potentially significant, inventoried sites that are not considered “fire sensitive” to be included in burn units. If amendment 3 is not implemented, all significant, or potentially significant, inventoried sites within burn units, regardless of if they are considered “fire sensitive” or not, would be managed for “no effect.”

Amendment 1 (Kaibab NF): If amendment 1 is implemented, the same effects that are described above (amendment 2 for the Coconino NF) would apply to the 27,637 acres to be managed for an open reference condition.

Amendment 2 (Kaibab NF): If amendment 2 is implemented, it would have minimal effect on the implementation of prescribed fire proposed under alternative B on the Kaibab NF because there would be only minor differences from current conditions.

Alternative C

Amendment 1 (Coconino NF): If amendment 1 is implemented, the resulting decreases in canopy base height, canopy bulk density, and canopy cover would have the indirect effect of slightly decreasing crown fire potential for the 18 MSO PACs that would receive mechanical treatments. An additional indirect effect would be to increase the ability of fire managers to implement prescribed fire within PACs because of decreased potential fire behavior. If amendment 1 is not implemented on the Coconino NF, these 18 PACs (approximately 10,700 acres) would retain the current forest structure that places them at high risk of high-severity fire. Potential fire behavior would make it difficult to implement prescribed fire because of narrow burn windows (weather and fuel conditions that would produce the desired fire effects and behavior). If prescribed fires were implemented on acres adjacent to PACs, it would be more likely that some fire lines would need to be created to avoid burning, producing ground disturbance that would be less likely under the proposed amendment. There would be little effect on emissions, except for a slight decrease in potential emissions in the event of wildfire following mechanical treatments within the PACs.

Amendment 2 (Coconino NF): If amendment 2 is implemented, it would allow 29,017 acres to be managed for an open reference condition. An indirect effect of managing for open conditions would be to have little potential for active crown fire, moving these acres toward desired conditions. Open conditions would, in the long run, produce fewer emissions because of less litter and debris from trees and the greater herbaceous component to surface fuels. If amendment 2 is not implemented on the Coconino NF, some treatments could be implemented, but these acres would not move as far toward desired conditions as they would be with the amendment.

Amendment 3 (Coconino NF): If amendment 3 is implemented, it would allow fire to be used to meet objectives if it was determined to be the best tool. Additionally, it would allow all significant, or potentially significant inventoried sites that are not considered “fire sensitive” to be included in burn units. If amendment 3 is not implemented, all significant, or potentially significant, inventoried sites within burn units, regardless of if they are considered “fire sensitive” or not, would be managed for “no effect.”

Amendment 1 (Kaibab NF): If amendment 1 is implemented, the same effects that are described above (amendment 2 for the Coconino NF) would apply to the 27,675 acres to be managed for an open reference condition.

Amendment 2 (Kaibab NF): If amendment 2 is implemented, there would be an additional 400 acres of mechanical and prescribed fire treatments that would move those acres toward desired condition (over alternatives B and D), as well as allowing more flexibility for laying out burn units in adjacent areas. If amendment 2 is not implemented, some of those acres could be burned under “operational burn,” but most would not move as far, or at all, toward desired condition.

Amendment 3 (Kaibab NF): If amendment 3 is implemented, the effects would be minimal, because the biological opinion from the FWS is expected to differ only minimally from current direction.

Alternative D

The effects would be the same as described for alternative B.

Cumulative Effects

The cumulative effects boundary includes the project area, the South Rim of Grand Canyon National Park, and an area approximately 15 miles south and west of the project area to encompass areas that could be affected by fire from prevailing winds. Because RU 6 (Tusayan district) is removed from the main project area, the cumulative effects analysis includes projects and events that specifically affect (or have affected) RU 6 and projects and events that affect (or have affected) the remainder of the project area.

The timeframe considered for past projects is 2000 to 2010. Foreseeable projects extend approximately 10 years into the future. This timeframe accounts for when the majority of actions were or will be completed and for measuring fire effects from prescribed fire and the effects of treatment on potential wildfire behavior.

Past Projects and Natural Disturbances

Eight thinning and broadcast burn projects (2000 to 2010) totaling approximately 42,737 acres (completed near, adjacent to, or within) in RU 6 have affected potential fire behavior and effects in the treatment area. Some of the larger projects include Long Jim, Scott, Ten X, Topeka, and Tusayan East. See the fire ecology report for the complete list of projects by year and acres. Approximately 32,702 acres of wildfire occurred in or around RU 6 from 2000 to 2010. Some of the larger wildfires include Camp 36 (3,052 acres, 2003), Ruby (4,107 acres, 2009), and Mudersbach (7,260 acres, 2005).

In the remainder of the cumulative effects analysis area, approximately 204,839 acres of mechanical treatment/prescribed fire, and 151,782 acres of wildfire from 2000 to 2010 have decreased the potential for active crown fire and crown fire initiation. Some of the larger wildfires include Wildhorse (13,790 acres, 2009) and Schultz (15,075, 2010). Some of the larger vegetation and prescribed fire projects include City (12,400 acres, 2005) and East Clear Creek (19,977 acres, 2006).

The combined effects of mechanical/prescribed fire treatments and wildfires have created a mosaic of stand conditions within the treatment (project) area and much of the cumulative effects boundary, decreasing the potential for undesirable fire behavior and effects. The scattered large blocks of treatments with decreased fire behavior potential would continue to contribute to this mosaic of stand conditions, resulting in a more fire-adapted landscape.

Current, Ongoing, and Foreseeable Actions

Current, ongoing, and reasonably foreseeable management activities including mechanical and prescribed fire treatments would decrease the potential for crown fire by breaking up the vertical and horizontal continuity of canopy fuels. There are seven ongoing and foreseeable projects within RU 6 that are likely to impact fire behavior and effects within the proposed treatment area. Some of the larger projects include Russell (8,000 acres, 2011) and Tusayan East (2,600 acres, 2011).

There are approximately 204,368 acres of mechanical treatments and 242,617 acres of prescribed fire ongoing or planned within the remainder of the analysis area in forested areas that could impact fire behavior and effects within the proposed treatment area (see fire ecology report).

Cumulative Effects – Alternative A

Alternative A would continue to maintain RU 6 with potential for high-severity fire effects. Alternative A would not contribute to improving the structure, composition, and patterns of the project area. It would not put the ponderosa pine forests—or the vegetative communities that are cohorts of ponderosa pine—on trajectories toward being resilient and sustainable. The treatment area would continue to become less adapted to fire, increasing the potential for undesirable fire behavior and effects when wildfires do occur.

Cumulative Effects – Alternatives B, C, and D

Overall, the combined effects of current, ongoing, and reasonably foreseeable management activities would augment the effects of proposed treatments to decrease the potential size and severity of wildfires. These areas also may augment the potential size and increase the flexibility of locating burn units, because the moderated fire behavior in burned and/or thinned areas would allow prescribed fire to be implemented with broader burn windows and with higher intensity fire while still meeting control and resource objectives.

Treatments proposed in alternative B would move 509,195 more acres toward desired conditions for fire behavior and effects across the project area. When the proposed treatments are considered with past wildfires and past, current, ongoing, and reasonably foreseeable management activities, the effects would complement each other on large (project area), mid (RU), and small (subunit) scales, creating mosaics at all scales of potential fire behavior and effects, dominated by low-severity fire. The proposed treatments would fill in most of the acres between past, current, ongoing, and foreseeable management activities, creating a more cohesive restored landscape across the project area.

Treatments proposed in alternative C would move 562,380 more acres toward desired conditions for fire behavior and effects across the project area. Most of the effects would be identical to alternative B, with the exception of PACS and grasslands that would be treated, further augmenting the cumulative effects of the proposed actions and past wildfires, and past, current, ongoing, and reasonably foreseeable management activities.

Treatments proposed in alternative D would move 489,029 more acres toward desired conditions for fire behavior and effects across the project area. The proposed treatments would fill in most of the acres between past, current, ongoing, and foreseeable projects, creating a more cohesive restored landscape across the project area. Some 388,526 acres would not move as far toward desired conditions, and some areas would retain potential for crown fire and high severity surface fire as surface fuel loading increased following thinning, increasing the potential intensity of surface fires.

Air Quality

The air quality analysis is part of the fire ecology report which is incorporated by reference (Lata 2013). This analysis addresses Issue 1, prescribed fire emissions. Smoke/emissions were evaluated quantitatively by modeled emission quantities in pounds per acre for the most common stand condition under different treatment scenarios. Additionally, changes in those fuel components which produce the greatest percentages of emissions when they burn (litter, duff, and CWD greater than 3 inches) were modeled and mapped for a qualitative assessment.

Emissions and Public Health

Air pollutants called particulate matter include dust, dirt, soot, smoke, and liquid droplets directly emitted into the air by sources such as factories, power plants, cars, construction activity, fires, and natural windblown dust. The Clean Air Act establishes National Ambient Air Quality Standards (NAAQS) for six principal pollutants that pose health hazards: carbon monoxide (CO), lead, nitrogen dioxide, particulate matter less than 10 microns in size (PM_{10}), particulate matter less than 2.5 microns in size ($PM_{2.5}$), ozone, and sulfur dioxide.

The pollutant form of greatest concern from wildland fire—including both prescribed fires and wildfires—is particulate matter (PM) (Ottmar 2001, Graham 2012), although fire also creates other criteria pollutants and visibility impacts. Studies of human populations exposed to high concentrations of particles (sometimes in the presence of SO^2) and laboratory studies of animals and humans indicate there is potential for detrimental effects on human health.

The major subgroups of the population that appear to be most sensitive to the effect of particulate matter include individuals with chronic obstructive pulmonary or cardiovascular disease of influenza, asthmatics, the elderly, and children. Particulate matter also soils and damages materials and is a major cause of visibility impairment.

Radioactive Emissions

Concerns have been raised about the potential for smoke from prescribed fire treatments proposed in 4FRI to contain radioactive substances. During the Cerro Grande Fire of 2000, there was considerable public concern regarding the potential release of radionuclides from the Los Alamos National Laboratory (LANL). The evidence suggests that some adverse health effects did result from breathing high concentrations of particulate matter in the smoke (NMED 2002). Such exposures are associated with any forest fire. Deposition of LANL derived chemicals and radioactive materials from the smoke plume to the soil was minimal (2002 LANL).

Following the Cerro Grande Fire that burned the city of Los Alamos and the LANL in New Mexico in 2000, the U.S. Environmental Protection Agency (EPA), New Mexico Environment Department (NMED), and LANL partnered with the Department of Energy to operate radiological monitoring systems as well as to initiate several studies to assess impacts of the fire. The results of these efforts with regard to air quality and human health impacts indicated that radionuclides originating from the LANL site during the Cerro Grande Fire were restricted to naturally occurring radionuclides. LANL, the Department of Energy, and NMED monitored radionuclide concentrations in smoke from the Las Conchas Fire that burned through the Los Alamos area in the summer of 2011 and reported no significant detection levels. (See the NMED Web site: http://www.nmenv.state.nm.us/aqb/WildfireSmokeResources).

A study that included Lockett Meadow, within the 4FRI analysis area, found levels of radioactive materials in the soil were no different than background levels and would provide no added human health risk (Ketterer et al. 2004, Graham 2012a).

Communication with the EPA (Gerdes 2012, Graham 2012) and studies that addressed these emissions (Schollnberger et al. 2002) indicate that radioactive isotopes and other undesirable chemicals are present in wildfire emissions. Some are naturally occurring chemicals that have always been present at some level in wildfire smoke, and some have resulted from the weapons testing that occurred in the mid-20th century. The level of smoke that the public is exposed to would not pose as great a risk as wildfire would. Radioactive material that may be carried in the smoke plume carries a risk of human health concerns of less than 1 chance in 10 million (NMED 2002) and the greatest health risk is from breathing high concentrations of particulate matter in the smoke.

Smoke Sensitive Areas and Sensitive Receptors

The “Regional Haze State Implementation Plan for Arizona” defines “sensitive receptors” as “population centers such as towns and villages, campgrounds and trails, hospitals, nursing homes, schools, roads, airports, mandatory Class I Federal areas, etc. where smoke and air pollutants can adversely affect public health, safety, and welfare” (see appendix A of the specialist report). Several smoke sensitive areas lay within the airsheds of the areas proposed for treatment (table 62).

Table 62. Smoke sensitive areas and sensitive receptors

Area	Proximity to Implementation Area	Concerns
Flagstaff	Within boundaries or directly adjacent in all directions	Hospital, schools, human habitation, visibility, young children, interstate visibility
Williams	Within boundaries or directly adjacent in all directions	Hospital, schools, human habitation, visibility, young children, interstate visibility
Verde Valley	Less than 10 miles downslope south and southwest.	Hospital, schools, human habitation, visibility, young children
Grand Canyon National Park	Adjacent to the northern boundary of the 4FRI analysis area	Class I airshed, school, human habitation, campgrounds, visibility

The most sensitive smoke receptor in the State of Arizona is the Verde Valley, which is easily impacted with nuisance smoke from the cumulative burning on the southern part of the Kaibab NF, the eastern side of the Coconino NF, and the western side of the Prescott NF, as diurnal drainage of smoke from fires settles into this valley. Considerable coordination between forests takes place when burns and wildfires that can affect the Verde Valley take place, facilitated by the interagency Smoke Management Group housed at ADEQ.

Smoke monitors in the Verde Valley (Sedona and Camp Verde) track emissions concentrations, as well as equipment that captures images of visibility conditions. Spikes are found in particulate matter concentrations as smoke from fire activity on the surrounding forests settles into the valley at night, although levels have not exceeded NAAQS thresholds in the Verde Valley. Many complaints of smoke impacts in the Sedona area are primarily concerned with the reduced quality of highly valued scenic views of the Red Rocks. Table 63 lists most of the areas that are expected to be impacted to some degree by implementation of prescribed fires in the 4FRI treatment area. Figure 43 displays the general locations of airsheds that could be impacted by 4FRI actions. Airsheds 1, 3, and 5 are expected to experience the majority of the smoke impacts originating from the proposed treatment area, with rare instances of mild impacts in airshed 6.

Table 63. Areas expected to be impacted by proposed prescribed fire treatments

Communities	Roads	Recreation Areas
Camp Verde	Highway 180	Wupatki/Sunset Crater National Monuments
Cornville	Lake Mary Road (County Road 209)	Grand Canyon National Park
Cottonwood	Interstate 17	
Flagstaff	County Road 65	
	Highway 89A	
	Interstate 40	

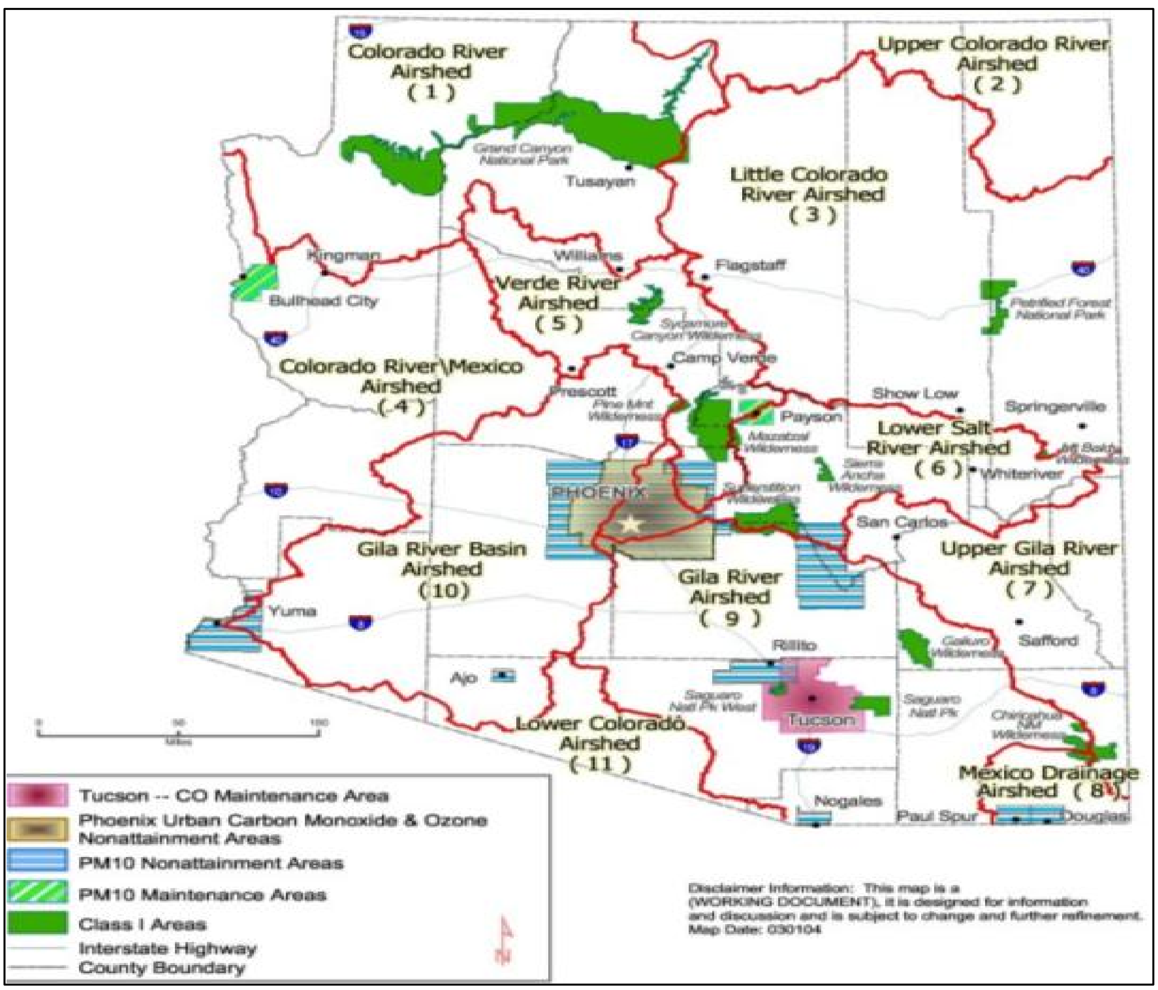


Figure 43. Airsheds defined by the Arizona Department of Environment Quality

Baseline visibility conditions (table 64) have been established for Grand Canyon National Park and Sycamore Canyon Wilderness which are the two Class I areas potentially affected by activities and wildfires in the 4FRI implementation area. Visibility in the Class I area of Sycamore Canyon Wilderness can also be affected by smoke from fires in the southeast portion of the Kaibab NF. The Forest Service is required to adhere to requirements in the Arizona State Implementation Plan to meet natural condition visibility goals.

Table 64. Baseline and 2064 goal in 2003 Arizona State Implementation Plan (SIP) for natural conditions

Class I Area	Baseline Data Years	Baseline Conditions	2064 Goal in 2003 AZ SIP
Grand Canyon NP	1999–2000, 2002–2004	11.6 dv	6.95 dv
Sycamore Canyon Wilderness	2001–2004	15.2 dv	6.96 dv

Regulatory Requirements

Prescribed fire is implemented only with approved site specific burn plans and with smoke management mitigation and approvals. All burning is conducted according to ADEQ standards and regulations. These standards include the legal limits to smoke emissions from prescribed burns as imposed by Federal and State law. The ADEQ enforces these laws by regulating the acres that are treated based on expected air impacts. These regulations ensure that effects from all burning meet Clean Air Act requirements. Prescribed fires are initiated under conditions that allow managers to meet both control objectives (fire behavior) and resource objectives (fire effects, including air quality impacts).

Kaibab NF and Coconino NF Prescribed Fire

The Kaibab NF has burned approximately 8,000 acres per year with prescribed fire in ponderosa pine since 2000. When wildfire acres are added, the Kaibab NF averaged approximately 17,000 acres a year (in ponderosa pine) from 2001 through fall of 2010.

From 2001 through fall of 2010, the Coconino NF averaged a little over 13,000 acres of prescribed fire in ponderosa pine. When wildfire acres are added, the Coconino averaged approximately 20,000 acres in ponderosa pine for that same period. No notice of violation of NAAQS has ever been issued to the Kaibab NF. Over the same period of time, one exceedance occurred on the Coconino NF. It occurred on one monitor for 1 day for an exceedance in PM_{10} in Flagstaff in 2007.

Environmental Consequences

Throughout this section, changes directly attributable to proposed actions, such as thinning or prescribed fire, are direct effects. These include changes to canopy bulk density, canopy base height, consumption of surface fuel, etc. Changes to the potential behavior and effects of wildfires that result from the direct effects are considered indirect effects.

Alternative A

In the short term (less than 20 years), effects of alternative A would include an increased risk of undesirable behavior and effects from wildfires (see "Fire Ecology" section). Average annual acres burned with wildfire would increase, along with the acres burned with high-severity fire and the associated air quality impacts. In the long term, if the current average annual acres burned by wildfire remained the same, it is likely that the entire treatment area would burn with wildfire by 2050, along with the associated air quality impacts. In the absence of wildfire, air quality would remain at current levels.

Environmental Consequences Common to Alternatives B, C, and D

- Implementing prescribed fire as proposed would result in lower emissions than if the area burned in a wildfire because there would be less biomass to burn.
- Prescribed fires implemented for the projects listed would comply with the regulations and requirements of the ADEQ and any burning done in the proposed treatment areas would comply with the NAAQS.
- Air quality impacts would be most likely to those portions of the Little Colorado River Airshed east and northeast of Flagstaff; the Colorado River Airshed north of Williams and including all of the treatment area in RU 6; and the Verde River Airshed. There would be a small chance that there could be some impact to the northern portions of the Lower Salt River Airshed.
- When units are ignited, smoke would be expected to travel on prevailing winds, away from sensitive receptors, and dissipate. Most smoke would dissipate, but some may persist at the surface. Short-term nighttime smoke could settle down the drainages into the towns below, particularly during early morning hours. Nighttime smoke would be expected to reside in low areas downslope from the burn units, because nighttime winds are generally calm. Daytime smoke would be expected to dissipate mostly downwind from the burn unit. Burn plans written for implementation of the proposed prescribed fires would include modeling to determine the most appropriate conditions under which to burn in order to minimize smoke impacts.
- In the short term, as first entry burns are implemented, impacts would increase noticeably. Acres with high fuel loading would be burned, in a first step toward restoring the natural fire regime. In subsequent entries, the same acres would produce less smoke, along with maintaining an ecosystem that is resilient to fire and benefits from it. In the long term, once an area has been burned once, there would be less fuel and, thus, lower emission potential. The combination of lower fuel loads and larger burn units would allow more acres to be burned without exceeding NAAQS.

Alternative B

Under this alternative, prescribed fire would be implemented on up to 58,792 acres annually to produce an average fire return interval of 10 years across 584,924 acres proposed for prescribed fire. Initial entry burns would produce much more emissions per acre than subsequent burns (see discussion on page 159 to page 161 in the fire report). However, even if the slash was removed from the forest and although the prescribed fires would be spread over many years, the acres to be burned would increase significantly and maintenance burning would be required across the treatment area to maintain a low fuel load and a healthy forest.

Smoke impacts may increase under this alternative because both the Coconino and Kaibab NFs already burn almost as much as they can (given burn windows and other limitations on prescribed burning, including emissions). Under alternative B, the number of acres available for prescribed fire would increase by 584,924 acres, which would average an additional 58,792 acres a year. This, in turn, would increase the flexibility for the forests in laying out burn units and managing prescribed fires. With potential for larger burn units, it would be possible to burn “hotter,” so that, although more acres may be burned at one time, the heat created by increased fire behavior could provide more “lift” for the smoke, increasing dispersal and minimizing smoke impacts.

Alternative C

Under this alternative, an average of 59,321 acres would need to receive prescribed fire every year. The effects (indirect) would be almost identical to those in alternative B, with the exceptions being the additional acres of MSO habitat and grasslands proposed for burning. Most acres in PACs and nest cores would be first entry burns that would initially produce a greater volume of smoke. However, surface fuel loads would not be burned in one entry; therefore, smoke would be dispersed over time. In the long term, the alternative would minimize wildfire emissions and effects and allow prescribed fire to be used in the future with lower emissions.

Alternative D

Alternative D proposes to treat 388,526 with mechanical thinning treatments only. Approximately 17,875 acres would need to burn each year to meet a 10-year fire return interval. At some point, these acres (as with most acres within the treatment areas) are likely to burn with wildfire. Under those circumstances, there would be little warning, little control over the smoke, and a great deal more smoke than if prescribed fire was used.

Alternative D proposes to thin but not burn 70 percent of the treatment area. Approximately 388,526 acres would produce emissions as displayed in figure 44 in the column labeled “only mech” (refers to mechanical) treatment before wildfire and 178,753 (burn only) acres would produce emissions displayed in the column labeled “wildfire after burn only treatments.”

Forest Plan Amendments

See “Fire Ecology Environmental Consequences” section.

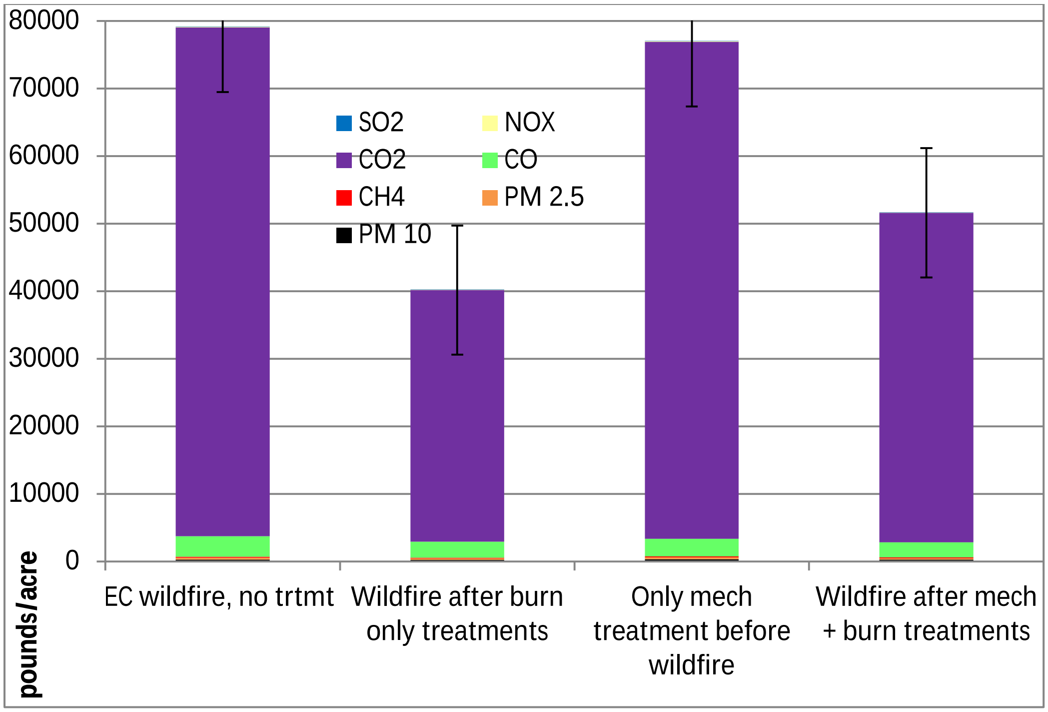


Figure 44. Emissions from surface fuels burning in wildfires after various treatments

Cumulative Effects

The cumulative effects of prescribed fires on the Coconino, Kaibab, and Prescott NFs over the last 12 years has resulted in one exceedance of NAAQS on one monitor for 1 day for PM_{10} in Flagstaff in 2007. Past treatments and wildfires in the last 10 years have decreased the potential emissions by removing canopy fuels, mostly from thinning on approximately 63,000 acres, and by increasing canopy base height, from wildfire and prescribed fire. Low-severity fire would have consumed surface fuels, further decreasing potential for emissions on approximately 151,000 acres. In some areas of high-severity fire, canopy fuels were consumed leaving tree stems and branches which have the potential to smolder for days or weeks (see “Fire Ecology” section for complete list of projects considered for cumulative effects).

There are approximately 18,436 acres of prescribed burns planned in RU 6 and Grand Canyon National Park by 2020. The Colorado River Airshed and the Little Colorado River Airshed have potential for air quality impacts from fires occurring within RU 6 and Grand Canyon National Park. It is likely that similar burn windows will be needed for many of the fires in the park and parts of RU 6.

The emissions from 244,000 acres of prescribed fire in the remainder of the analysis area would be managed in compliance with regulations and requirements of the ADEQ. There would be potential for air quality impacts to the Peaks and Sycamore Canyon Wilderness areas. The Colorado River Airshed, the Little Colorado River Airshed, and the Verde River Airshed are likely to have some air quality impacts from fires occurring in the southern part of the analysis area.

Alternative A

Air quality would be unaffected by prescribed fire from the treatment area, but would be affected by prescribed fires from other projects as noted above. Emissions from 244,000 acres of prescribed fire from current, ongoing, and reasonably foreseeable projects would be managed in compliance with regulations and requirements of the ADEQ. As with prescribed fires, wildfires occurring in the untreated areas would produce more emissions in areas that were not treated and could augment the effects of prescribed fires on air quality. Areas with potential for impact would be the Colorado River Airshed, the Little Colorado River Watershed, and the Verde River Watershed. Class 1 airsheds that could be affected include Grand Canyon National Park and Sycamore Canyon Wilderness.

Alternatives B and C

All prescribed fires would be implemented in compliance with ADEQ regulations and requirements as well as forest plan direction to meet legal standards and provide for public safety. Emissions from prescribed fires proposed in alternatives B and C would utilize many of the same burn windows that the approximately 244,000 acres of current, ongoing, and reasonably foreseeable projects would use. However, the increased acres of prescribed fire would allow more flexibility for implementation, making it possible to burn more acres at once with the same impacts. Areas with potential for impact would be the Colorado River Airshed, the Little Colorado River Watershed, and the Verde River Watershed. Class 1 airsheds that could be affected include Grand Canyon National Park and Sycamore Canyon Wilderness. As more acres are treated, there will be broader burn windows, potentially resulting in more days of prescribed fire and days of air quality impacts.

Alternative D

RU 6 is adjacent to Grand Canyon National Park, a Class 1 airshed and one of the most heavily visited national parks in the United States. Burn windows for the burns proposed in the action alternatives would be the similar to those for the current, ongoing, and reasonably foreseeable future actions.

The potential for undesirable air quality impacts from prescribed fire would be the same as other alternatives because all prescribed fires are regulated by the same laws regarding allowed emissions. Areas with potential for impact would be the Colorado River Airshed, the Little Colorado River Watershed, and the Verde River Watershed. Class 1 airsheds that could be affected include Grand Canyon National Park and Sycamore Canyon Wilderness. In most of the area that was thinned and not burned (388,526 acres), there would be potential for greater wildfire emissions from increased surface fuel loading. When combined with emissions from current, ongoing, and reasonably foreseeable management actions, there would be potential for greater air quality impacts when wildfires burned in these areas than in areas that had been previously treated with low-severity fire.

Terrestrial and Semiaquatic Wildlife and Plants

This section includes key effects and conclusions for terrestrial, semiaquatic, and plant threatened, endangered, and proposed species and critical habitat listed under the Endangered Species Act of 1973, as amended, Forest Service Southwestern Region Sensitive Species, forest management indicator species, and migratory birds. The wildlife (Noble et al. 2013) and botany report (Crisp 2013) are incorporated by reference. Aquatic species were analyzed separately.

See the specialist reports (project record) for detailed information on methodology, analysis assumptions, best available science and data, habitats, populations, and effects that are not repeated in this section.

Vegetation Cover Types and Habitat Stratification

The dominant cover types within the project area are described in the “Vegetation” section. All ponderosa pine forested habitat within the project area was stratified to meet analysis requirements in the forest plans (USDA 1987, 1988) for Mexican spotted owl (MSO) and northern goshawk.

Wildlife Habitat Condition in the Project Area

Forest structure, forest health, vegetation composition and diversity, and fire behavior are highly departed from desired conditions. Chapter 1 of the DEIS describes how existing conditions are affecting wildlife habitat and function.

Habitat Connectivity

Current forest structure is much denser in terms of trees per acre and canopy continuity than pre-settlement conditions for ponderosa pine in northern Arizona. Concern was expressed by the public that the scale and intensity of vegetation treatments would affect the connectivity of species that require closed canopy conditions. Chapter 1 of the DEIS provides the existing condition of canopy openness. The “Vegetation” section in this chapter evaluates how each alternative would affect canopy density and openness.

Using the post-treatment vegetation modeling output and extensive list of design features that would be incorporated into project implementation, the wildlife analysis evaluated potential impacts to habitats. In summary, the evaluation found that adequate areas of densely forested habitat would remain available to wildlife adapted to closed canopy conditions during the period of time between 4FRI treatments and the actual attainment of desired conditions across the broader landscape. This habitat would bridge the time between treatment and attaining truly sustainable forest conditions, allowing species adapted to closed canopies to adjust, adapt, or eventually relocate over time rather than face an abrupt transition in forest conditions. This bridge habitat would include about 13 percent of the landscape within the 4FRI project boundary that would be deferred from treatment. Nearly 42 percent of the ponderosa pine treatment area would have a moderately closed canopy and 17 percent would remain in a closed condition. Another 17 percent of the treated area would have a mix of open and closed conditions. Restoration units near the Mogollon Rim would provide the greatest percentage of bridge habitat after treatment. In addition, landscape-scaled corridors would be designated to account for movement of closed canopy species across the area. The complete analysis for bridge habitat for canopy-dependent wildlife can be found in appendix G of the DEIS and appendix 3 of the wildlife report.

Federally Listed Threatened, Endangered, Proposed Candidate Species, and Designated Critical Habitat, and Forest Service Sensitive Species

The following list of federally threatened, endangered, and proposed species was adopted from the Coconino and Kaibab NFs' lists of species. Only those federally listed threatened, endangered, candidate species and their critical habitat, along with Forest Service sensitive species that are known or have potential to occur within the 4FRI project area were analyzed (table 65). Table 66 lists species that are not present or do not have potential habitat in the project area and were, therefore, dismissed from further analysis.

Table 65. Threatened, endangered, candidate, and sensitive species evaluated in this analysis

Scientific Name	Common Name	Status
Amphibians (1)		
Lithobates pipiens	Northern Leopard Frog	S
Birds (7)		
Strix occidentalis lucida	Mexican Spotted Owl and critical habitat	T
Haliaeetus leucocephalus	Bald Eagle	S
Accipiter gentilis	Northern Goshawk	S/MIS/Mig Bird[1]
Falco peregrinus anatum	American Peregrine Falcon	S
Aechmophorus clarkia	Clark's Grebe	S
Athene cunicularia hypugaea	Burrowing Owl (western)	S/Mig Bird
Buteo regalis	Ferruginous Hawk	S/Mig Bird
Insects (3)		
Piruna polingii	Four-spotted Skipperling	S
Speyeria nokomis nitocris	Nitocris Fritillary	S
Speyeria nokomis Nokomis	Nokomis Fritillary	S
Mammals (10)		
Mustela nigripes	Black-footed Ferret	E
Microtus mogollonensis Navaho	Navajo Mogollon Vole	S
Microtus longicaudus	Long-tailed Vole	S
Sorex merriami leucogengys	Merriam's shrew	S
Sorex nanus	Dwarf Shrew	S
Lasiurus blossevillii	Western Red Bat	S
Euderma maculatum	Spotted Bat	S
Idionycteris phyllotis	Allen's Lappet-browed Bat	S
Corynorhinus townsendii pallescens	Pale Townsend's Big-Eared Bat	S

Scientific Name	Common Name	Status
Eumops perotis californicus	Greater Western Mastiff Bat	S
Reptiles (1)		
Thamnophis rufipunctatus	Narrow-headed Garter Snake	S
Plants (9)		
Cimicifuga arizonica	Arizona bugbane	S
Astragalus rusbyi	Rusby milkvetch	S
Clematis hirsutissima var. hirsutissima	Arizona leatherflower	S
Hedeoma diffusum	Flagstaff pennyroyal	S
Helenium arizonicum	Arizona sneezeweed	S
Penstemon clutei	Sunset Crater beardtongue	S
Penstemon nudiflorus	Flagstaff beardtongue	S
Rumex orthoneurus	Blumer's dock	S
Salix bebbiana	Bebb's willow	S

Status: E = Federally Endangered; T = Federally Threatened; C = Federal Candidate; S = Forest Service Sensitive; Mig Birds = Migratory Birds
[1] Analyses for MIS and migratory birds can be found below.
[2] Note that MSO are analyzed as a threatened species under the ESA.

Table 66. Threatened, endangered, candidate, and sensitive species not addressed in this analysis

Scientific Name	Common Name	Rationale	Status
Amphibians (3)			
Lithobates chiracahuensis	Chiricahua leopard frog	Neither the species nor its habitat occurs in the project area	T
Bufo microscaphus microscaphus	Southwestern (Arizona) toad	Neither the species nor its habitat occurs in the project area	S
Lithobates yavapaiensis	Lowland leopard frog	Neither the species nor its habitat occurs in the project area	S
Birds (6)			
Empidonax traillii extimus	Southwestern willow flycatcher	Neither the species nor its habitat occurs in the project area	E
Gymnogyps californianus	California condor	Not known to occur in project area (random occurrence may happen)	E/Exp-NonE
Rallus longirostris yumanensis	Yuma clapper rail	Neither the species nor its habitat occurs in the project area	E
Coccyzus americanus occidentalis	Western yellow-billed cuckoo	Neither the species nor its habitat occurs in the project area	C

Scientific Name	Common Name	Rationale	Status
Buteogallus anthracinus	Common black hawk	Neither the species nor its habitat occurs in the project area	S
Pipila aberti	Abert's towhee	Neither the species nor its habitat occurs in the project area	S
Mammals (2)			
Perognathus amplus cineris	Wupatki Arizona pocket mouse	Neither the species nor its habitat occurs in the project area	S
Reithrodontomys montanus	Plains harvest mouse	Neither the species nor its habitat occurs in the project area	S
Reptiles (2)			
Thamnophis eques megalops	Northern Mexican garter snake	Neither the species nor its habitat occurs in the project area	C
Heloderma suspectum suspectum	Reticulate Gila monster	Neither the species nor its habitat occurs in the project area	S
Plants (19)			
Packera franciscana (*Senecio fransciscanus*	San Francisco Peaks ragwort	Neither the species nor its habitat occurs in the project area	T
Purshia subintegra	Arizona cliffrose	Neither the species nor its habitat occurs in the project area	E
Agave delamateri	Tonto Basin agave	Neither the species nor its habitat occurs in the project area	S
Agave phillipsiana	Grand Canyon agave	Neither the species nor its habitat occurs in the project area	S
Arenaria aberrans	Mt. Dellenbaugh sandwort	Species is not known to occur in the analysis area	S
Botrychium crenulatum	Crenulate moonwort	Species is not known to occur in the analysis area	S
Carex ultra	Cochise sedge	Species is not known to occur in the analysis area	S
Chrysothamnus molestus	Disturbed rabbitbrush	Species is not known to occur in the analysis area	S
Cirsium parryi ssp. *mogollonicum*	Mogollon thistle	Species is not known to occur in the analysis area	S
Desmodium metcalfei	Metcalf's tick trefoil	Species is not known to occur in the analysis area	S
Erigeron saxatilis	Cliff fleabane	Habitat for this species is on steep canyon walls and is not likely to be affected by management actions including burning.	S
Eriogonum ericifolium var. ericifolium	Heathleaf wild buckwheat	Neither the species nor its habitat occurs in the project area	S

Scientific Name	Common Name	Rationale	Status
Eriogonum ripleyi	Ripley wild buckwheat	Neither the species nor its habitat occurs in the project area	S
Helianthus arizonensis	Arizona sunflower	Species is not known to occur in the analysis area	S
Heuchera eastwoodiae	Eastwood alum root	Species is not known to occur in the analysis area	S
Pellaea lyngholmii	Lyngholm's brakefern	Neither the species nor its habitat occurs in the project area	S
,Platanthera zothecina	Alcove bog orchid	Neither the species nor its habitat occurs in the project area	S
Polygala rusbyi	Hualapai milkwort	Neither the species nor its habitat occurs in the project area	S
Salvia dorrii ssp. mearnsii	Verde Valley sage	Neither the species nor its habitat occurs in the project area	S

Status: E = Federally Endangered; T = Federally Threatened; C = Federal Candidate; S = Forest Service Sensitive; E/Exp-NonE = Experimental nonessential

Mexican Spotted Owl (MSO)

All ponderosa pine/Gambel oak forest habitat within the project area was stratified by MSO habitat potential to meet analysis requirements in the forest plans (USDA 1987, 1988). See the preceding "Vegetation" section for a description of the stratification. For the purposes of this analysis, the project area is the larger 988,764-acre unit and the ponderosa pine treatment area is 512,178 acres.

There are 99 protected activity centers (PACs) within the project area. The project area includes all State, private, and Federal lands as well as designated wilderness, current and recent project areas on the individual ranger districts, and mixed conifer vegetation. The treatment area contains about 36,455 acres of MSO protected habitat of which 35,566 acres are within 72 designated PACs that are considered occupied. The remaining protected habitat (889 acres) occurs on steep slopes where timber harvest has not occurred in the previous 20 years. There are about 76,091 acres of restricted habitat, including 8,713 acres of threshold and target habitat. For the purpose of the MSO discussion, the treatment area includes only those ponderosa pine lands managed by the FS which are proposed for mechanical and/or prescribed fire activities.

Six critical habitat units (CHUs) occur partially or completely within the 4FRI project area (see the wildlife specialist report for approximate locations and descriptions. Figure 45 displays all MSO habitat within the 4FRI treatment area.

Surveys and Monitoring

Annual MSO monitoring on the Coconino and Kaibab NFs is highly variable. Some PACs are rarely monitored while others are monitored nearly every year. Monitoring summaries for each forest from 1987 to 2011 are presented in the wildlife report.

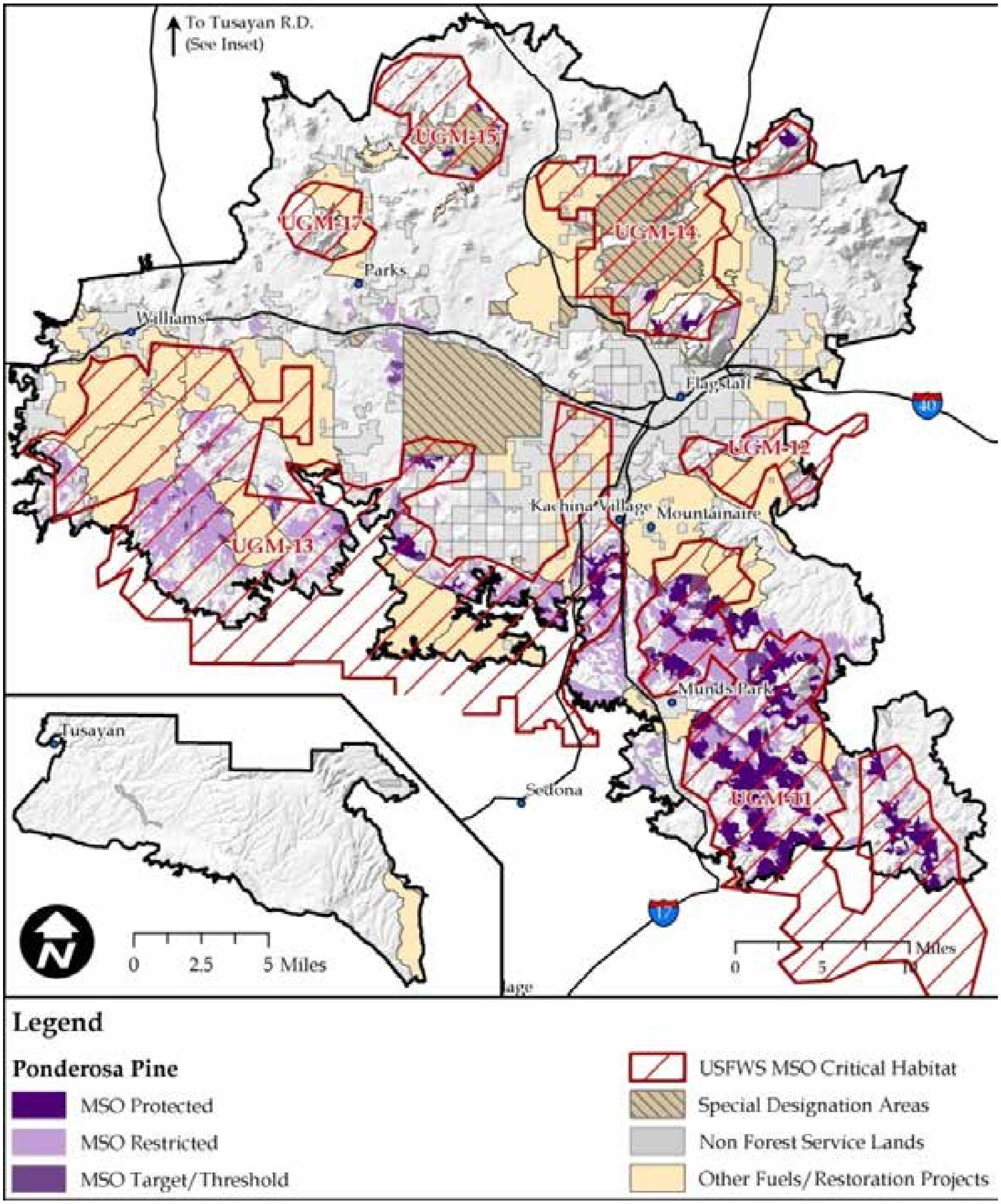


Figure 45. Mexican spotted owl habitat within the 4FRI treatment area

Summary of Habitat Conditions

All MSO habitats are at risk from stand density-related mortality. There is an imbalance in tree size classes leading to a lack of diversity in tree ages and structural diversity. There is a deficit of large trees (greater than 18-inch d.b.h.)—particularly trees greater than 24-inch d.b.h.—and there are threats to existing big and old trees because of competition from smaller trees. Large snags are also deficit when compared to forest plan and MSO recovery plan desired conditions[10]. Snags and CWD requirements are met on less than 10 percent of the habitat (see chapter 1, table 7). Canopy cover in habitat selected by MSOs is higher than average forest values and can range from 50 percent to greater than 80 percent (USDI 1995). There is decreased quality in prey habitat due in part to uncharacteristic canopy connectivity from ingrowth of smaller trees inhibiting herbaceous understory development.

The existing condition for surface fuels within the 4FRI treatment area is directly related to forest density. As a result, MSO habitat also has a higher fuel buildup at ground level. According to fire modeling, about half of the total MSO habitat in the treatment area would support some form of crown fire with nearly a third of MSO habitat (33,549 acres) at risk of active crown fire (table 67). Although the desired condition is returning fire behavior to predominantly surface fire, current fuel loading presents threats to MSO prey habitat from both the risk of crown fire and uncharacteristic surface fire.

Table 67. Predicted fire behavior in existing MSO habitat

MSO Habitat Type	Habitat Acres	Surface Fire Acres (% of Habitat)	Passive Crown Fire Acres (% of Habitat)	Active Crown Fire Acres (% of Habitat)	Conditional Acres (% of Habitat)
Protected	36,757	18,610 (51)	3,141 (9)	9,930 (27)	14,847 (41)
Target/ Threshold	8,713	4,292 (49)	926 (11)	2,854 (33)	3,479 (40)
Restricted	67,378	35,465 (53)	6,608 (10)	20,764 (31)	25,187 (37)

MSO Habitat – Environmental Consequences

Alternative A – Direct and Indirect Effects

The vegetation analysis evaluates the effects to forest structure in MSO habitat including snags, down logs, and CWD. Overall, alternative A does not meet the purpose and need for the project. While individual projects would move some habitat toward desired conditions, MSO habitat at the 4FRI landscape level would continue to degrade over time in terms of forest structure and health. Development of the large tree component would continue to be compromised by density dependent competition and mortality. Tree growth rates would stagnate, compromising future recruitment into larger size classes. Understory development would remain suppressed and continue to decline.

Other habitats important to prey species such as meadows, aspen, springs, and ephemeral channels would continue to degrade or be lost entirely over the long term. Roads within the 4FRI that have been identified for closure under travel analysis process assessments would remain open, negatively impacting forest attributes important to MSO and allowing potential for disturbance to birds to remain. No 4FRI specific disturbance would occur but disturbance from other projects and from the existing road network would continue. MSO habitats would be on a

[10]No specific desired conditions exist for snags in the 12-inch to 18-inch category in MSO habitat.

trajectory moving further from desired conditions as described in the Coconino and Kaibab forest plans.

Alternatives B, C, and D – Direct and Indirect Effects

The environmental consequences for alternatives B, C, and D reflect the incorporation of forest plan standards and guidelines, BMPs, and Forest Service Manual and Handbook direction. See the "Wildlife" portion of appendix C for design features and mitigation. Habitat elements used to evaluate the alternatives for MSO include: forest structure and density, MSO prey habitat, fire effects, other habitat changes, and disturbance.

- At the project area scale, improvements to prey habitat through spring, ephemeral channel, meadow, and aspen treatments within protected habitat would be limited and site specific. However, these treatments would enhance prey habitat in areas proximate to nesting owls where foraging is key during the reproductive season. MSOs in the UGM feed primarily on peromyscus mice and voles (Ganey et al. 2011), and restoration treatments could benefit these species by improving understory vigor and productivity (Kalies et al. 2012, Martin and Maron 2012). Analysis of adaptive management actions for springs and ephemeral channels indicated they would not result in additional effects which are not already disclosed/addressed in the individual alternative discussions.
- Overall changes to PAC habitat would be limited, but would focus on improving important structural elements like large tree development and retention, and reduced risk of high-severity fire. Treatments in restricted "other" habitat would provide diversity in habitat structure which would enhance prey populations and increase forest resiliency while providing for owl dispersal.
- Fire and smoke effects from prescribed fire may disturb individual birds in and adjacent to the treatment area, but timing restrictions and low-severity burn prescriptions would reduce impacts and largely lead to no or only short-term effects. However, the amount of burning across the landscape under alternatives B, C, and D creates the potential of smoke settling into a PAC, potentially leading to adverse effects to individual owls.
- Road maintenance, reconstruction, temporary road construction, and decommissioning within PACs would all take place outside of the breeding season. Project activities would be phased to ensure that not all MSO habitats are treated simultaneously, thus reducing the overall effects by spreading them across a broad area and over time. Review of adaptive management actions for road-related activities indicated they would not result in additional effects that are not already disclosed/addressed in the individual alternative discussions.

Forest Structure in PACs

Forest structure, such as trees 18-inch d.b.h. and greater, describes nest and roost site characteristics. In alternatives B, C, and D changes in forest structure within PACs would be small and reflect the careful design of treatments to move forest structure toward desired conditions while retaining dense stands with closed canopies. Trees 12 to 18 inches d.b.h. decrease across all alternatives. These mid-aged trees are currently in abundance. The largest drop in the mid-aged size class would be in alternative C and would be consistent with the lower minimum basal area associated with the draft recovery plan guidance for nest/roost characteristics. Implementation of alternative C would require a forest plan amendment, see appendix B. All alternatives would increase trees greater than 18 inches d.b.h. Results would be similar among alternatives, but alternative C would yield the largest increase in big trees. Increases in large trees would include trees greater than 24 inches d.b.h. as well. Ponderosa pine basal area would decrease in all action alternatives, which is a treatment objective, with alternative C showing the largest decrease and alternative D the smallest decrease due to the lack of prescribed fire.

Forest Structure in Ponderosa Pine – Oak Restricted Habitat

Current forest plan and MSO recovery plan direction require that at least 10 percent of MSO restricted habitat be designated as threshold habitat. Threshold habitat represents forest structure simultaneously meeting nesting and roosting criteria. There is deficit in the amount of existing threshold stands across the landscape. No stands simultaneously meeting threshold conditions would be brought below minimum threshold values in any alternative. The recovery plan also defines target habitat as areas approaching, but not currently meeting, forest structure conditions described in table III.B.1 of the MSO recovery plan (USDI 1995: page 92). Target stands should be managed toward achieving nesting and roosting habitat. Treatments would decrease the percentage of trees less than 18 inchs d.b.h. and increase trees greater than 18 inches d.b.h. in all action alternatives.

Trees 12- to 18-inch d.b.h. would decrease and trees greater than 24 inches d.b.h. would increase in all action alternatives. Changes in threshold habitat would be similar to those in PACs due to the limited scale of work being proposed. Target habitat would see more change, but typically this would be limited to a couple percentages per tree size class or a couple trees per acre 18-inch d.b.h. and larger; trees greater than 24-inch d.b.h. would consistently increase in all RUs. Changes in restricted “other” habitat would follow the same pattern with the scale of change being a few percentages or trees per acre.

All action alternatives would have the same mechanical treatments in restricted “other” habitat. Because alternative C would adopt a minimum basal area value of 110 as recommended in the MSO recovery plan, more trees in the 12- to 18-inch d.b.h. class would be cut. As a result, fewer trees would grow into the 18- to 23.9-inch d.b.h. category relative to alternatives B and D. Growth rates for trees 18- to 23.9-inch d.b.h. would increase in alternative C, moving more trees into the next size class of 24 inches and greater d.b.h. Therefore, alternative C would have fewer trees 18- to 23.9-inch d.b.h. but the most trees 24-inch d.b.h. and larger. Alternatives B and D produced similar values for forest structure in restricted habitat. BA would be higher for both pine and oak under alternative D because of the limited use of fire in this alternative.

Canopy Structure

Stand density index (SDI) is an important measure of forest density and can inform canopy structure. Percent maximum SDI in target and threshold habitat would range from the low to mid-70s (“extremely high density”) in all action alternatives. Treatments in restricted “other” habitat would result in percent maximum SDI values in the upper 30s (“high density”) for alternatives B and C, and 46 in alternative D. Alternatives B and C would result in similar densities and alternative D had the highest densities in terms of percent maximum SDI. All values would result in forest conditions with closed canopies. Given post-treatment values for basal area and trees per acre by tree size class, canopy cover would be 50 percent or greater at the group level (see silviculture report for details).

Only ponderosa pine would be harvested, so while individual trees of other species might be affected by mechanical and burning operations, the existing variability in overstory species would remain after treatments. Prescribed fire would improve subcanopy flight space for MSOs by lifting crown base height. Combined, these factors should improve the elements of canopy structure such as cover, density, flight space, and maintain species diversity in the overstory.

Prey Habitat

Prey habitat is another key component of MSO habitat. In threshold habitat, snags greater than 18-inch d.b.h. would decrease by 0.1 to 0.2 snags per acre across all action alternatives, relative to alternative A. In target habitat, snags in alternative B would equal alternative A, snags in alternative C would decrease by 0.2 per acre and in alternative D snags would increase by 0.1 per acre. Snag values would be about equal across alternative in restricted “other” habitat. In both threshold and target habitats logs would decrease in all alternatives but still remain about double the forest plan guidelines. Logs would be similar across all alternatives in restricted “other” habitat, remaining at or above forest plan guidelines in each alternative. CWD would be at the upper end of forest plan guidance in threshold and target habitats for alternatives B and C, and exceed forest plan guidance in alternative D. Values for CWD in restricted “other” habitat would be within forest plan direction for alternatives B and C, and exceed recommended values in alternative D in three of four RUs. RU 5 would have lower amounts of CWD, with alternatives B and C below 4 tons per acre. Alternative D would have about 6.3 tons per acre in RU 5, the lowest average in any RU under alternative D. The limited number of acres proposed for burning in alternative D would result in the most prey structure remaining on the ground. In other words, without broadcast burning occurring across most restricted habitat, alternative D would retain the largest amount of surface fuels. However, this could decrease herbaceous response and not represent an actual improvement to prey habitat above the other alternatives while increasing the risk of a surface fire becoming a crown fire.

Understory response would be low in MSO habitat, reflecting the desired condition for relatively dense forests with closed canopies. The relative index for biomass response remained below 30 pounds per acre in threshold habitat and below 70 pounds per acre in target habitat. Alternative C had the highest response and alternative D the lowest. Results for restricted “other” habitat were much higher, relative to areas managed for nesting and roosting habitat, with values generally ranging from 130 to 180 pounds per acre except for RU 5 where results for alternatives B and C were about 283 pounds per acre. Alternative D would again be consistently lower than alternatives B and C.

All action alternatives were more than three times the values for the no action alternative, reflecting the improvements to prey habitat the proposed treatments could achieve. However, the relative biomass response would be based largely on changes in basal area. It would not include broadcast burning benefits to understory plants such as reduced pine litter and associated nutrient pulse. Therefore, the advantages from implementing alternatives B and C are underrepresented when comparing results to treatments proposed under alternative D.

Fire Effects

All three action alternatives would move large acreages of ponderosa pine forest out of FRCC 3 immediately after treatments are completed. Alternative C moves all treated acres out of FRCC 3. Alternative B has the next fewest acres in FRCC 3 after treatment and alternative D has the most acres remaining in FRCC 3 of the action alternatives. In comparison, nearly 60 percent of total acres would be in FRCC 3 under alternative A. Simultaneously, alternatives B and C would move nearly a fifth of total treated acres into FRCC 1. In 2020, alternative D would have fewer acres in FRCC 1 than the existing conditions. Moving the overall landscape toward FRCC 1 would decrease the risk of undesirable fire behavior and effects to MSO habitat.

Fire modeling resulted in similar patterns, in terms of meeting desired conditions, as that shown for FRCC. Patterns for changes in fire behavior in protected habitat are similar to those for ponderosa pine forest in general. Action alternatives would move most of the habitat into surface fire conditions in 2020. However, alternatives B and C would move most of the ponderosa pine and about three-quarters of MSO protected habitat into conditions likely to support surface fire. Alternative D would move most of the ponderosa pine but less than 60 percent of the protected habitat toward surface fires. The remaining acres would remain vulnerable to high-severity fire. It is worth noting that the wildlife analysis for the Kaibab forest plan concluded the Kendrick PAC consisted of mixed-conifer habitat. The Kaibab NF used a mid-scale analysis (100 to 1,000 acres) for evaluating effects of the proposed land management plan. The 4FRI analysis was analyzed on a finer scale that delineated individual pine-oak stands within the Kendrick PAC. About 173 acres of pine-oak habitat outside the core area were identified for burn-only treatment in the Kendrick PAC during the 4FRI analyses of potential PAC treatments. The nearby Stock Tank PAC, administered by the Coconino NF, has about 15 acres of pine-oak habitat occurring on the Kaibab NF that is also proposed for burn-only treatments. The 15 acres are within the PAC but outside of both the core area and Kendrick Peak Wilderness.

Disturbance

Disturbance could occur as a result of project-related activities including moving and operating harvest machinery, hauling forest materials, building fire line, managing prescribed burns, smoke, personnel in the field, and road maintenance and reconstruction. Noise disturbance from project activities may disturb foraging MSO. Noise would not be expected to disturb nesting or roosting MSO because haul routes are planned to either avoid PACs (occur more than a ¼ mile from core areas) or employ timing restrictions to avoid disturbance during the nesting season. Alternatives B and D would mechanically treat 84,177 acres of MSO habitat. Alternative C would mechanically treat 82,344 acres of MSO habitat; about 1,833 acres less than alternative B or D.

Core areas would be protected from prescribed fire by using roads, natural barriers, or new fire line to contain burn units. Building line would occur outside the nesting season. Noise and smoke related to burning could disturb owls. Design features would include timing restrictions so that habitat in and around PACs would not be prescribed burned during the breeding season (March 1 to August 31). The area excluded from burning around PACs would be determined on a PAC-by-PAC basis. Roads, topography, and prevailing weather patterns would be identified so that an adequate buffer would be defined around PACs. Burning within the buffer would be conducted in association with PAC burning outside the breeding season. This would include core areas in alternative C. Site-specific buffers would be designed so that noise and settling smoke from burning outside the buffer would not disturb resident owls in the PACs during the breeding season. Appropriate distances for individual PACs would be decided by biologists, fuels specialists, and the FWS. As a result, smoke and noise are not expected to result in negative effects to MSO. Alternative B would treat 107,696 acres with prescribed fire, alternative C would treat 112,546 acres of MSO habitat, and alternative D would prescribe burn 3,543 acres of MSO habitat.

Other Features within MSO Habitat

Roads

About 164 miles of road (table 68) are proposed for decommissioning within MSO habitat (17 percent of the 962 total open roads in MSO habitat) in each action alternative. Roads proposed for decommissioning by MSO habitat type and total miles of proposed road decommissioning are the same in each alternative. About 15 percent of the 793 miles of road within MSO critical habitat is proposed for decommissioning. Road decommissioning within MSO habitat would improve habitat conditions for MSOs and their prey.

Table 68. Alternatives B, C, and D miles of road decommissioning in all MSO habitat

MSO Habitat	Miles of Roads Proposed for Decommissioning	Existing Road Miles	Percent of Roads Proposed for Decommissioning
Protected	49	251	20
Core Area[1]	5	20	20
Target/Threshold	17	82	21
Restricted Other	98	624	16
Total	**164**	**957**	**17**

[1] Core area acres are a subset of protected habitat totals

Road maintenance (nearly 98 miles) and temporary road construction (about 7 miles) would affect almost 105 miles of roads in protected habitat (table 69). Road maintenance and temporary road construction within PACs would take place outside of the breeding season. The term "temporary roads" in this instance includes nonsystem roads that currently function as open roads on the landscape. These roads would also be decommissioned outside of the breeding season after 4FRI project implementation.

A road system for hauling harvested materials out of the forest was identified to implement restoration activities. Haul routes were evaluated across the entire project area relative to MSO PAC habitat. This broad-scale effort was evaluated in a site-specific manner as roads around each individual PAC were examined in terms of functional haul routes and avoiding disturbance to MSOs. The objective was to assess road systems for hauling materials with the goal of avoiding or minimizing impacts to MSOs. The miles associated with road maintenance, construction, and reconstruction are the same in alternatives B, C, and D.

Dust abatement treatments would occur in selected areas where private landownership concerns could arise. Eight road segments have been identified for dust abatement, totaling less than 7 miles in length. The average dust abatement treatment length would be about 0.9 miles, ranging from 0.3 to 2.5 miles. Treatments would consist of magnesium chloride ($MgCl_2$) or lignin. The effectiveness of $MgCl_2$ is related to humidity levels (Batista et al. 2004); therefore, lignin would probably be used most often in the 4FRI landscape. Treatments would be temporary and only occur on particular road segments in association with hauling. None of the proposed treatment segments would be near open water. Because of the limited application spatially and temporally, and because locations do not include sensitive areas such as open water, dust abatement is not expected to result in measurable effects to wildlife or their habitat.

Table 69. Alternatives B, C, and D road maintenance, temporary roads, and reconstruction in MSO habitat in miles

MSO Habitat	Road Maintenance	Temporary Road Construction	Road Reconstruction	Total Miles of Road Work
Protected Total	97.6	7.2	0	104.8
Target/Threshold Total	40.9	5.3	≤0.05	46.3
Restricted	319.1	63.5	1.0	383.6
Total	**457.6**	**76.0**	**1.05**	**534.7**

About 115 miles of roads in restricted habitat (table 68) would be decommissioned across 15 different subunits, including nearly 17 miles within target and threshold habitat. About 458 miles of road maintenance would occur in MSO habitat. New temporary road construction would total about 76 miles (table 69). Over a mile of road would be relocated to protect ephemeral stream channels. Two road segments would be relocated in target (1) and threshold (1) habitat, totaling less than 0.04 mile in length and the balance would be in restricted "other" habitat. No road relocation would occur in protected habitat.

Springs, Ephemeral Channels, Meadows, and Aspen

Spring and ephemeral stream restoration activities would be the same in all action alternatives. Restoration of springs and ephemeral channels would be evidence based and designed to improve vegetation composition. Pre-settlement trees would remain where present and the largest trees available would be left where there is evidence of other pre-settlement trees. Twenty-three springs are in MSO habitat, including protected (5) and restricted (18) habitats. Over 4 miles of ephemeral stream channel restoration is proposed within MSO habitat. Spring and channel restoration would occur in four of the six CHUs occurring within the treatment area, enhancing prey habitat. Restoration activities proposed for springs and ephemeral channels would include two prescribed fires in a 10-year period: first entry and second entry maintenance prescribed fires. The wildlife report contains additional information on the location of springs and streams within MSO habitat.

Up to 135 acres of meadow treatments are proposed in 12 different PACs, depending on the alternative. Meadow treatments within PACs are intended to improve existing meadow habitat by removing encroaching conifers. Meadow habitat within PACs is important because it represents important prey habitat. Meadow treatments average 11 acres per PAC, ranging from 1 acre (Howard Mountain) to 28 acres (Meadow Tank). Treatment types vary by alternative and all PACs with proposed meadow treatments are located on the Coconino NF. Mechanical treatments would remove post-settlement trees, unless replacement trees would be necessary for evidence of pre-settlement trees. Meadow treatment objectives related to prescribed fire include removal/reduction in litter, raising a stand's crown base height, or deliberate tree mortality intended to restore the function of the habitat.

Approximately 1,471 acres of aspen, another important habitat for MSO prey, occur in the treatment area. Aspen treatments vary by alternative. Up to 209 acres of aspen are proposed for treatment in PAC habitat and up to 959 acres are proposed for treatment within critical habitat (UGM-11, UGM-13, UGM-14, UGM-15, and UGM-17).

Forest Plan Amendments

The MSO amendments are designed to allow treatments that were developed to create and sustain nesting and roosting habitat. If the amendments were not included as part of this alternative, the results of implementing the alternatives would be different from those analyzed below. By adhering to a 9-inch d.b.h. limit for cutting trees within PACs, about two-thirds of the PAC acres proposed for mechanical treatment would retain uncharacteristic basal areas and ladder fuels, and no fuels reduction would occur in 56 core areas. The result would be a higher risk of potential crown fire, elevated rates of density dependent tree mortality, and increasing the risk of overstory mortality from insects and disease. Post-treatment PAC habitat conditions would continue to limit the ability to retain large pine and oak trees and slow the development of future large trees and snags. Large pine and oak trees and snags are key components of nesting and roosting habitat. Restricting PAC treatments to 10 percent of the recovery unit would continue the risk of habitat loss for an extended period of time.

Not designating 10 percent of restricted habitat as threshold habitat on the Kaibab NF would not be expected to affect MSOs (see following analysis). Similarly, designating 10 percent of restricted habitat as threshold habitat would also not be expected to affect MSOs. Habitat use by MSOs across the Williams Ranger District is in mixed conifer forest on top of the mountainous cinder cones or in Sycamore Canyon. If MSO use of this habitat occurs, it is likely for foraging or dispersal. Managing for an extra 2 percent of nesting and roosting habitat would not likely affect either behavior. However, maintaining high tree densities in areas that historically did not likely have the canopy closure and stem densities associated with owl nesting and roosting habitat would negatively affect other wildlife species (see amendment analyses for sensitive, management indicator, and migratory bird species). Similarly, managing future nesting and roosting habitat with a lower minimum basal area value, as described in the MSO recovery plan, would not likely affect MSOs in the short term. By definition, these are areas with no known resident owls. However, these minimum values represent stand or area averages, with groups of trees creating higher and lower values. Managing future nesting and roosting habitat at the higher basal area values may decrease the ability to maintain these areas in the long term due to the risk of potential crown fire and insect and disease related mortality.

The amendments proposed for managing canopy cover and open reference conditions in goshawk habitat (Coconino and Kaibab NFs), management in the proposed Garland Prairie RNA (Kaibab NF), and cultural resource determinations (Coconino NF) would not affect MSOs or their habitat.

Cumulative Effects – All Alternatives

The complete analysis for cumulative effects to MSOs is discussed in detail in the wildlife specialist report. Cumulative effects were evaluated across the 4FRI treatment area plus a ½-mile buffer beyond. The cumulative effects area includes 110 PACs. Effects from recent/past projects (since 1996) are assumed to potentially contribute to short-term effects in association with 4FRI treatments which would extend through the year 2020. Current and ongoing projects could potentially contribute to long-term effects (considered 30 years post-treatment or the year 2050).

Projects before 1996 are incorporated into existing conditions. Aspects of existing conditions that are a result of these early projects include a deficit in large trees and snags and even-aged conditions. Pre-1996 projects also had heavy selection pressure for preferred tree genetics to provide healthy trees with good form. Wildlife habitat in the form of nesting, feeding, and loafing sites was reduced by selecting for disease-free trees with symmetric shapes, eliminating forktop trees, trees with unusual branching patterns, and replanting with selected genetic stock from nurseries.

Current and ongoing projects identified in MSO habitat within the 4FRI area have or will treat a total of about 6,500 acres. This equates to nearly 3,000 acres of protected habitat and about 3,500 acres of restricted habitat. Most acres treated from these projects involve mechanical harvest or burning treatments, but also include slash disposal, invasive weed treatments, and limited acres of animal damage control, erosion control, and disease tree harvest (see appendix 12 of the wildlife report).

Most of the habitat identified as part of the ongoing and foreseeable cumulative effects analysis would occur outside of MSO habitat. However, there are treatments specifically designed to treat MSO habitat. Total acres of MSO habitat treatment is not yet known because some projects are still in the planning and analysis stages. However, the best estimate at this time includes about 10,155 acres of protected habitat and approximately 23,800 acres of restricted habitat under consideration for vegetation treatments.

Alternative A

Maintaining existing conditions would extend the current deficit of trees greater than 24-inch d.b.h. Growth could be further suppressed and mortality rates increased if long-term climate patterns continue toward hotter and drier growing conditions. Within-stand mortality resulting from competition for rooting space, water, and nutrient availability could lead to patches of more open conditions. This could reduce potential nesting and roosting habitat even in locations where individual trees might eventually grow into larger size classes.

Pine-oak habitat would remain outside the historical range of variability in terms of tree densities and age class distribution under alternative A. Loss of large diameter oak would continue, as would the suppression of young oak by competing pine trees. Large-scale stochastic events could continue to slow or prevent development of new MSO nesting and roosting habitat.

The lack of road closures along with firewood cutting, would maintain the same threat to large snag persistence. Ecosystem function would continue to decline with continued tree encroachment into spring, channel, meadow, and aspen habitats.

The ability to retain sustainable and resilient ecosystems would be further compromised by vulnerability to high-severity fires. The overt threat of high-severity fire could limit options for treating uncharacteristic fuel loads through the use of unplanned ignitions, compounding the fire risk through time. By not treating adjacent to MSO habitat, the risk of high-severity fire remains high from ignitions starting outside of pine-oak habitats as well as fire igniting within MSO habitat.

Cumulative Effects for Alternatives B, C, and D

Changes to MSO habitat structure as a result of these (4FRI, ongoing, and foreseeable) actions are expected to be minimal. None of the treatments would be expected to measurably decrease the number of trees greater than 12-inch d.b.h. Trees 18-inch d.b.h. or greater would be unaffected by the fuel reduction/restoration treatments. Total basal area of pine would decrease, but given the focus on small trees, their removal may not substantially alter total stand basal area. Gambel oak would not be targeted for removal and the total basal area of Gambel oak is not expected to change substantially in the long term.

The reduction in small trees should open the space between ground level and crown base height, improving MSO flight paths for foraging. However, d.b.h. limits from past projects commonly resulted in loss of forest structure and a decrease in inherent heterogeneity in tree spacing. Reduced crown fire risk and increased understory production that result with diameter-capped treatments tend to be short-term because creation of interspace and irregular tree spacing typically cannot be attained.

Changes are expected in MSO prey habitat. Decreases would occur in CWD, logs, and snags. Burn prescriptions and ignition techniques should limit overall losses of logs and snags. Burned snags will fall and provide logs, and trees killed by fire will become snags. The longevity of fire-killed snags would be less than that of snags formed from other processes. However, maintenance burning should provide pulses of snags and logs through time. Less CWD is expected to be present as a result of prescribed fire.

Thinning and burning should increase tree growth rates and self-pruning of the lower tree branches through time should gradually replenish CWD. Improving growing conditions should decrease density-related mortality of larger and older trees. Improving recruitment into the larger size classes will improve MSO habitat and the ability to provide large snags that remain on the landscape longer than smaller diameter or fire-created snags. The combination of thinning and burning should improve species richness in the herbaceous understory, increase plant abundance, and improve fruit and seed production. The projects considered for cumulative effects are areas that were omitted from the 4FRI planning effort because planning was already in progress or recently completed. Treating within these polygons will reduce fire threat for MSO habitat within the respective project polygon as well as reducing the threat of high-severity fire starting in these projects and burning habitat outside the polygons.

Cumulative effects include local disturbance from noise and potentially additional disturbance from smoke. The individual projects include the Williams Ranger District (Bill Williams Mountain) and projects distributed across the Flagstaff district from the San Francisco Peaks to the edge of the Mogollon Rim. Given the various stages of planning or implementation, project effects are dispersed both spatially and temporally. Given the scale of the 4FRI treatment area (593,211 acres), the amount of MSO habitat within the treatment area (112,546 acres) and the period of time over which treatments will be implemented (10 or more years), the cumulative effects are expected to be negligible relative to the scale of both time and space within which potential effects would occur.

Critical Habitat (Alternatives B, C, and D)

The primary constituent elements essential to the conservation of the owl include those physical and biological features that support nesting, roosting, and foraging. Primary constituent elements for MSO critical habitat within pine-oak forest provide one or more habitat needs for nesting, roosting, foraging, and include:

Forest structure:

- A range of tree species of different sizes and ages;
- Thirty to 45 percent of the trees 12-inch d.b.h. or greater;
- Shade canopy of 40 percent or more;
- Snags of 12-inch or greater d.b.h.; and

MSO prey habitat:

- High volume of fallen trees and other woody debris;
- A wide range of tree and plant species, including hardwoods;
- Adequate levels of residual plant cover to maintain fruits, seeds, and plant regeneration.

Critical habitat includes both protected and restricted habitat, as defined in the MSO recovery plan. Six CHUs occur within or overlap the 4FRI project area, encompassing about 488,974 total acres. Approximately 91,047 acres of protected and restricted critical habitat in the 4FRI treatment area are within designated CHU boundaries. Effects to critical habitat are averaged across habitats (see discussion of effects to protected and restricted habitats by alternative in preceding discussion). Many of the differences between alternatives are limited when assessed at the scale of critical habitat. Overall, proposed mechanical treatment acres are similar between alternatives, but vary in terms of acres proposed for prescribed fire.

Comparisons of most attributes are done for the year 2050 to allow for changes in forest development to become more readily apparent. The main exception is the relative index value for understory development which is compared for the year 2020 when herbaceous response to treatments is maximized. After that, tree growth would increase and the canopy would continue developing, causing a persistent decrease in understory response through 2050.

Forest Structure

The distribution of tree size classes would be similar among alternatives, with alternatives B and C nearly identical, and alternative D frequently 1 or 2 percentages below them for trees greater than 18-inch d.b.h. All action alternatives had the same values for trees per acre 18-inch d.b.h. and greater. Forest densities would remain high, limiting the benefits of MSO treatments in terms of forest health and resiliency, but treatments would focus on releasing large trees from competition, increasing growth rates of large trees, and retaining or creating nesting and roosting habitat.

Pine basal area would be reduced by all the action alternatives. Total basal area post treatment would be about the same in alternatives B and C. Gambel oak basal area and total basal area would consistently be higher in alternative D. The higher basal area values in alternative D would result from the limited acres of prescribed fire in this alternative.

The basal area, trees per acre, and SDI values post-treatment would provide for canopy cover. No species other than ponderosa pine would be targeted for selection, unless small trees of other species are within a crown diameter of old tree ponderosa pine or large Gambel oak (see design features in the wildlife report) would remain in the canopy ensuring species diversity and structural heterogeneity. Some oak would be lost to fire, particularly in alternatives B and C. Design features would be in place to minimize loss of larger oak. Fire would also be expected to stimulate oak sprouting. Canopy continuity would be maintained in protected and target and threshold habitats, but some defined tree groups and canopy openings would be created in restricted “other” habitat. Combined, this would retain nesting and roosting habitat in protected and target and threshold habitats and move restricted “other” habitat toward a blend of denser forest with an interspersion of increased foraging opportunities.

MSO Prey Habitat

Snag habitat would be provided in MSO habitat. Results for snags greater than 12-inch d.b.h. (the measure for critical habitat) would be similar among alternatives. Nevertheless, alternative C would consistently rank lower and alternative D would consistently rank higher in snag densities. Most CHUs would average five or more snags per acre greater than 12-inch d.b.h., although UGM-12 and UGM-13 would average 2.5 to 3 snags per acre. Creating more large trees and improved growth rates for large trees should help ensure future snag recruitment (USDI 1995). Logs per acre would be maintained across critical habitat with similar results among action alternatives, although the pattern would continue with relatively lower values in alternative C and higher values in alternative D. Values for CWD would be similar between alternatives B and C, but typically several tons per acre higher in alternative D. This is directly correlated with the reduced acres of prescribed fire in alterative D. It is expected that low severity prescribed fire would leave a patchy mosaic in alternatives B and C, including unburned areas. Small mammals, including key MSO prey species, tend to respond positively to restoration-based treatments (appendix 7 of the wildlife report). Levels of CWD exceed forest plan guidance in all alternatives.

The pattern in understory response would be different from other habitat components in that alternatives B and D were similar, with alternative B consistently higher. Overall, a greater response would occur under alternative C as a result of higher treatment intensity. Prey populations would be expected to benefit from retaining these structural elements after treatments and prey species response would be expected to be greatest in alternative C and least in alternative D.

Fire Effects

Fire effects by alternative for protected and restricted habitats, including the no action alternative, are discussed in the previous MSO habitats discussion. In association with those discussions are displays of FRCC and fire behavior for ponderosa pine forest in general, as well as for each action alternative. The results would be the same for critical habitat: treatments would move all or most of the acres of MSO habitat from FRCC3 to FRCC1 and 2. Fire behavior would shift from 30 to 40 percent active crown fire, to 1 to 6 percent active crown fire in restricted habitat.

Patterns for changes in fire behavior in protected habitat are similar to those for ponderosa pine forest in general: action alternatives would move most of the habitat into surface fire conditions in 2020. Alternatives B and C would move most of the ponderosa pine and about three-quarters of MSO protected habitat into conditions likely to support surface fire. Alternative D would move most of the ponderosa pine but less than 60 percent of the protected habitat toward surface fires. The remaining acres would remain vulnerable to high-severity fire.

Consistency with MSO Biological Opinions (2012)

Based on a review of the 2012 land and resource management plan (LRMP) biological opinions (BO) (USDI 2012a, 2012b) and information discussed in the above effects analysis, implementation of any of the action alternatives would be consistent with the forestwide programmatic LRMP biological opinions for the Coconino and Kaibab National Forests and that a forest plan amendment is not necessary.

Black-footed Ferret (Endangered)

There are presently no known naturally occurring populations of black-footed ferret. There are no known records of black-footed ferrets on the Coconino or Kaibab NFs. Black-footed ferrets are dependent upon prairie dogs for food and burrows, and Gunnison' prairie dogs are the only prairie dog species that occurs in northern Arizona. Within the project area, prairie dogs occur in grasslands. Open linkages have been mapped within the project and are identified for prairie dogs (wildlife report, appendix 4).

Environmental Consequences

Alternative A – Direct and Indirect Effects

Habitat conditions for black-footed ferret would remain in their current condition, notwithstanding natural processes. Because there are no known black-footed ferrets on the project area, the probability of direct effects to black-footed ferrets from the current condition are low. Understory biomass would continue to decline over the next 40 years (appendix 8 of the wildlife report). This, in turn, leads to less available habitat for species such as the ferret that rely on prairie dogs for food.

Stability of key ecosystem components such as species composition, forest structure, soil characteristics, and hydrologic function are at moderate to high risk of loss in the event of high-severity disturbance, such as high-severity wildfire, on 76 percent of grasslands. This alternative would result in the most stress on meadow and grassland habitats and, thus, would have the greatest negative contribution to potential black-footed ferret habitat.

Cumulative Effects of Alternative A

The area analyzed for cumulative effects to black-footed ferret encompasses the grasslands within the project area and the associated prairie dog complexes. Direct and indirect effects are unlikely to occur since there are no known locations of black-footed ferrets on the project area and potential habitat will be surveyed prior to implementation. There are no effects to black-footed ferret therefore, no cumulative effects.

Summary of Alternatives B, C, and D – Direct and Indirect Effects

Direct effects are unlikely to occur in any action alternative since there are no known locations of black-footed ferrets on the project area and potential habitat would be surveyed prior to implementation. Short term and localized effects from mechanical thinning and prescribed fire would result in the potential collapsing of burrows and displacement of prairie dogs in active prairie dog towns. In all alternatives, there would be restored connectivity of grasslands which would have a beneficial impact on prairie dog populations contributing to potential black-footed ferret habitat. There would be additional opportunities for prairie dogs to colonize new areas and recolonize areas where trees have encroached previously occupied habitat in Government and Garland Prairie, Kendrick Park, and other grasslands.

Alternative C treats the most acres and elicits the greatest response in understory (see wildlife report, appendix 8). Potential for high-severity fire in grasslands would be reduced with the removal of encroaching trees, and prescribed fire and mechanical treatments in grasslands would improve the stability of the key ecosystem elements by almost doubling acres in FRCC1 and reducing FRCC3 by half (see fire ecology report).

Alternative D produces the lowest response of understory biomass (see appendix 8 in the wildlife report) as there would be 20,645 fewer acres of prescribed fire only. There would be little change in high-severity fire potential and the lack of prescribed fire in grasslands reduces the acres in FRCC 1 by 3 percent and increases the acres in FRCC 3, reducing the stability of key ecosystem elements (see fire ecology report). The lack of burning means no nutrient pulse into the system, further limiting understory response. This alternative provides the least amount and lowest quality of habitat for prairie dogs hence less habitat for black-footed ferrets.

Forest Plan Amendments

The MSO amendments would allow managing for lower tree densities and basal area, creating canopy gaps, and increasing understory response. Not including amendments for MSO habitat would not affect ferret habitat because protected habitat does not overlap with grasslands or the forest matrix occurring between grasslands. The amendments would not affect resident or dispersing prairie dogs and, so, would not affect ferrets.

Not including the amendment related to management of canopy cover and open reference conditions within ponderosa pine forest would prevent the ability to include open rooting space between tree groups and prevent the restoration of grasslands and savanna. This would prevent the restoration of forested areas that used to support grasslands and decrease the ability to maintain existing grasslands, savannas, and meadows. Decreased dispersal would reduce the ability of prairie dogs to naturally establish new prairie dog towns and limit the “rescue effect” of genetic exchange between fragmented populations. If some prairie dogs are genetically resistant to plague, dispersal of these animals may be key to eventually establishing black-footed ferret habitat. Forest thinning, the creation of interspace, and reestablishing grasslands, savannas, and meadows would assist in enhancing the probability of successful dispersal.

Not managing the proposed Garland Prairie RNA (alternative C only) for the grassland characteristics it was intended to support would result in similar, though more localized, dynamics. Not including actions related to openness and grassland restoration would omit or limit herbaceous response, decreasing prairie dog food and cover.

Cumulative Effects for All Action Alternatives

The area analyzed for cumulative effects to black-footed ferret encompasses the grasslands within the project area and the associated prairie dog complexes. Direct and indirect effects are unlikely to occur since there are no known locations of black-footed ferrets on the project area and potential habitat will be surveyed prior to implementation. There are no direct or indirect effects to black-footed ferrets, therefore, no cumulative effects.

California Condor (Endangered/Experimental Population)

Reintroduction of captive-bred condors in Arizona began in 1996 at the Vermilion Cliffs National Monument Release Site. Condors were reintroduced under Section 10(j) of the Endangered Species Act (ESA) (USDI 1996a). Under this designation, the protections for an endangered species are relaxed, providing greater flexibility for management of a reintroduction program. The Arizona portion of the designated nonessential experimental population area boundary extends south from Utah to Interstate 40. U.S. Highway 191 (parallel to the New Mexico State border) is the east boundary and Interstate 15 to U.S. Highway 93 near Las Vegas, Nevada, is on the west. When condors leave this area, they receive full protection of the ESA, which may have regulatory implications. Portions of the Coconino and Kaibab NFs north of I-40 are within the designated experimental population area.

Between 2002 and 2006, The Peregrine Fund obtained more than 50,000 relocation fixes from an average of 17 GPS-equipped condors (Austin et al. 2007). Condor use is focused on the north and south rims and river corridor of the Grand Canyon, Kaibab Plateau, and Kolob area in southern Utah (approximately 70 miles north of the release site on the Paria Plateau). Condors do not spend much time south of the Grand Canyon. When they have traveled into the southern extent of the designated recovery zone, they head back north relatively rapidly. There are few reports of condors on the Coconino NF or the Williams or Tusayan Ranger Districts of the Kaibab NF (Parrish, pers. comm.). The Arizona condor population was at 74 as of March 2011 (AGFD 2012). The project would not affect nesting or roosting habitat and, because condors rarely occur within the project area, would not affect foraging habitat. Therefore, no further analysis will be conducted.

Forest Service Sensitive Species

Sensitive species are defined in Forest Service Manual 2670.5 as “those plant and animal species identified by a regional forester for which population viability is a concern, as evidenced by: (a) significant current or predicted downward trends in population numbers or density, or (b) significant current or predicted downward trends in habitat capability that would reduce a species’ existing distribution (USDA 2005).

The presence of 31 Forest Service sensitive species and golden eagles (protected under the Bald and Golden Eagle Protection Act) carried forward for analysis (table 70) was determined by consulting forest records, results of surveys conducted on the forests, and use of the FAAWN database (Patton 2011). The most recent Regional Forester’s Sensitive Species list was transmitted to forest supervisors on October 1, 2007, and is the basis for the species used for this analysis. Species in bold font apply to both the Coconino and Kaibab NFs. Other species apply to the Coconino NF.

See the “Aquatics” section for the sensitive species evaluation. Table 66, presented earlier, displays those species (with rationale) that were dismissed from this analysis.

The environmental consequences incorporate the springs, streams, and road adaptive management actions.

Table 70. Forest Service sensitive species or habitat occurrence in the project area

Common (Scientific Name)	Species or Habitat Occurrence in Project Area
Amphibians (1)	
Northern Leopard Frog *(Lithobates pipiens)*	In Arizona, northern leopard frogs are absent from most historic locations. Northern leopard frogs were reported in several subunits (1-2, 1-3, 1-4, 1-5, 1-6, 3-4, 3-5, 4-4, 4-5, 5-1) within the project area. Their range within the project boundary is now limited to permanent waters around Stoneman Lake. There are 6 occupied/critical breeding sites and 10 potential breeding sites in the project, or within a ¼ mile of the project area boundary, and they occur within subunits 1-2, 1-5, and 1-6. Best potential habitat within the project area is tanks and springs that provide permanent water. Although potential habitat occurs in

Common (Scientific Name)	Species or Habitat Occurrence in Project Area
	livestock waters in all cover types within RUs 1, 3, 4, and 5, the primary breeding and dispersal habitat occurs in RU 1 where the amphibian linkage is designated. RU 1 has 8,230 acres of grassland and 145,793 acres of ponderosa pine, 24 miles of riparian habitat and ephemeral streams, and 32 springs.
Birds (7)	
Bald Eagle (*Haliaeetus leucocephalus)*	There are two nesting pairs of bald eagles within the project boundary. One breeding area occurs above the Mogollon Rim near Lower Lake Mary. The same pair has used two different nest locations along Lower Lake Mary (Coconino NF). The area is periodically monitored by AGFD and Northern Arizona Audubon Society. The alternate nest location is adjacent to FR 296A and has a higher level of disturbance within the area. The second breeding area is at Whitehorse Lake on the Kaibab NF. This nest was first documented in May 2012 and is located in an area of high recreation use. The nest was monitored by AGFD and confirmed active with one fledged nestling. Bald eagles occurring on the Coconino and Kaibab NFs are primarily winter visitors. There are currently 38 eagle roosts spatially identified in GIS for the project area, of which 19 have confirmed use by bald eagles. The remaining 19 roosts are identified as characteristics roosts and do not have documented use by bald eagles. Bald eagle confirmed and characteristic winter roosts are found in seven sites. Potential habitat within the treatment area is 512,178 acres of ponderosa pine but is habitat primarily within 2.5 miles from bodies of permanent water (i.e. Upper and Lower Lake Mary, Horseshoe Lake, Mormon Lake, and Roger's Lake) and along major roadways (i.e. Interstates 17 and 40, U.S. Highways 89A and 89N and Forest Highway 3).
Northern Goshawk (*Accipiter gentilis)*	On the Coconino NF, opportunistic sightings and limited surveys were conducted in the 1980s and in 1990. Annual surveys were initiated in 1991. As of 2008, there were 70 known territories on the Coconino NF (see wildlife report, table 29). Goshawk territories have been established based on the results of surveys. Goshawk surveys were conducted in 2011 and 2012. There are currently 68 goshawk territories on the southern portion of the Kaibab NF, including 36 goshawk PFAs on the Kaibab NF portion of the project area. Goshawk surveys were conducted in 2011 and 2012. There are 30,600 acres of goshawk PFA, dispersal PFA and nest areas, and 369,033 acres of non-PFA.
American Peregrine Falcon (*Falco peregrinus anatum)*	There are 20 confirmed nesting pairs of peregrine falcons within the project area. Nests occur in eight subunits (1-1, 1-6, 3-1, 3-4, 3-5, 4-3, 4-4, and 5-1). Known nest locations, tall cliffs, open waters, and meadows provide potential habitat within the project boundary. Foraging habitat in the treatment area is primarily 48,774 acres of grassland, 39 miles of riparian habitat and ephemeral streams, and 74 springs and wetlands.
Clark's Grebe (*Aechmophorus clarkia)*	There is confirmed nesting at Mormon Lake southeast of Flagstaff (Coconino NF). Most potential habitat is located on Anderson Mesa (subunits 1-2 and 1-4), Marshall Lake (subunit 1-3) and Mormon Lake (subunit 1-5) (Coconino NF).Neither resident Clark's grebe nor their habitat have been identified on the Kaibab NF and they are not considered a sensitive species on the forest.
Burrowing Owl (western) (*Athene cunicularia hypugaea)*	Breeding Bird Atlas surveys confirmed nesting from approximately 100 feet elevation near Gladsden to 6,600 feet elevation in a prairie dog colony near Flagstaff (Coconino NF). However, burrowing owls have not been confirmed within the project area. There are 48,774 acres of grassland habitat within the treatment area that provides potential habitat for prairie dogs and, consequently, burrowing owls.

Common (Scientific Name)	Species or Habitat Occurrence in Project Area
Ferruginous Hawk (*Buteo regalis)*	Breeding Bird Atlas surveys confirmed nesting ferruginous hawks occupying a fairly narrow range of elevations, from 4,700 feet to 6,400 feet (Corman and Wise-Gervais 2005) with no documented nesting on the Coconino or Kaibab NFs. Ferruginous hawks forage in montane subalpine grasslands in the Flagstaff vicinity. There are 48,774 acres of grassland habitat within the treatment area that provide potential habitat for prairie dogs and, consequently, ferruginous hawks. The hawk is not considered a sensitive species on the Kaibab NF.
Insects (3)	
Four-spotted Skipperling (*Piruna polingii***)**	The four spotted skipperling is associated with mixed broadleaf deciduous and montane willow riparian forest, wetland cienega, and montane subalpine grasslands. Of these habitats, only montane subalpine grassland and wetland cienega occur in the treatment area. There are 48,774 acres of montane subalpine grassland and 74 springs in the treatment area.
Nitocris Fritillary (*Speyeria nokomis nitocris)*	Habitat includes mixed conifer, ponderosa pine, spruce-fir, montane willow riparian forests, and wetland cienega vegetation types. Of these, only the ponderosa pine and wetland cienega occur in the project area. It is a sensitive species for the Coconino NF. It has not been recorded on the Kaibab NF and is not considered a sensitive species for the forest where the habitat is too dry and water too ephemeral to provide habitat. Potential habitat within the project area is found throughout the 470,990 acres of ponderosa pine, 51 springs, and 85 miles of riparian habitat in RUs 1, 3, 4, and 5 within the treatment area.
Nokomis Fritillary (*Speyeria nokomis Nokomis)*	Within the project area, they are known from drainages in the San Francisco Mountains. It is a sensitive species on the Coconino NF. It has not been recorded on the Kaibab NF and is not considered a sensitive species for the forest where the habitat is too dry and water too ephemeral to provide habitat. Potential habitat within the project area is found in RUs 1, 3, 4, and 5. Within these RUs, there are 51 springs and 85 miles riparian habitat that provide habitat in the treatment area.
Mammals (9)	
Navajo Mogollon Vole ***(****Microtus mogollonensis Navaho****)***	Hoffmeister (1986) delineated the range for this vole from Navajo Mountain southward to the western part of the Mogollon Plateau, extending from near Mormon Lake westward toward the town of Williams and up to the Tusayan district. They occur within open forests and in larger grassland areas such as Garland and Government Prairies on the Williams district (Ganey and Chambers 2011). There are 512,178 acres of ponderosa pine and 48,774 acres of grassland within the treatment area.
Long-tailed Vole (*Microtus longicaudus*)	Small mammal surveys have not documented long-tail voles; however, they are expected to occur within the project area. Potential habitat within the treatment area is 48,744 acres of grassland, 51 springs, 85 miles of riparian habitat, and ephemeral streams. The vole is not found on the Williams or Tusayan RDs, only considered on North Kaibab RD for the Kaibab NF.
Merriam's Shrew (*Sorex merriami leucogengys***)**	Merriam's shrew is distributed throughout the west and Hoffmeister (1986) shows them distributed along the Mogollon Rim. No surveys have been completed. However, Merriam's shrews are expected to occur in ponderosa pine forests within the project area. There are 512,178 acres of ponderosa pine within the treatment area.

Common (Scientific Name)	Species or Habitat Occurrence in Project Area
Dwarf Shrew ***(****Sorex nanus****)***	The species is known to occur on the San Francisco Peaks and White Mountains (Hoffmeister 1986), however, shrews have not been documented in the project area. Potential habitat within the treatment area is 25,658 acres of pinyon-juniper, 512,178 acres of ponderosa pine, and 48,744 acres of grassland. The shrew is not found on the Williams or Tusayan RDs and only occurs on North Kaibab RD for the Kaibab NF.
Western Red Bat ***(****Lasiurus blossevillii****)***	In the Grand Canyon, Hoffmeister (1971) reports the western red bat were only found in the bottom of the canyon near Phantom Ranch and along Bright Angel Creek approximately 6 miles from the project area. On rare occasion, red bats have been documented near Kachina Village (subunit 3-4) and upper West Clear Creek Wilderness and Page Springs Fish Hatchery. The latter two locations are outside of the project area. One bat was radio-tracked near Kachina Village within the project area and roosted in a clump of Gambel oak in dry ponderosa pine forest (Chambers, pers. comm. 2010). Given they are an uncommon summer resident on the Coconino NF, they could conceivably be a rare visitor on the Kaibab NF as well. However, extensive netting on both the Williams and Tusayan districts failed to produce records of western red bats. There are 34 caves within 300 feet of the treatment area boundary. A 300-foot buffer around cave entrances and sinkhole rims is a design feature applicable to all action alternatives. Potential foraging habitat within the treatment area includes 512,178 acres of ponderosa pine and 48,774 acres of grassland. Roosting habitat may occur along the 39 miles of riparian habitat and ephemeral streams.
Spotted Bat ***(****Euderma maculatum****)***	Historic records suggest that the spotted bat is widely distributed, rare across its range, but can be locally abundant. In Arizona, spotted bats commonly roost singly in crevices in rocky cliffs and they have also been found in caves (Chambers, pers. comm. 2009). Cliff habitat and surface water are characteristic of localities where they occur. Meadows, openings, and open forests with diverse herbaceous ground cover provide habitat for prey species. There are 512,178 acres of ponderosa pine and 48,774 acres of grassland within the treatment area. Spotted bats have been captured in coniferous forests on the Kaibab Plateau over 25 miles from the project area and in other western states. Netting efforts have not resulted in captures on the Coconino NF or the Williams RD, but spotted bats were captured on the Tusayan district, RU 6 (Solvesky, pers. comm.2008). There are no known roost locations within the project area. Surveys of abandoned mines and natural caves on the districts did not detect any spotted bats (Corbett 2008).
Allen's Lappet-browed Bat **(***Idionycteris phyllotis***)**	A study conducted within the project area (RUs 1, 3, and 6) documented lappet-browed bats using snags for maternity roosts. Female roost trees were all within ponderosa pine forests. They occur across the ponderosa pine belt on the Coconino and Kaibab NFs and occurrences are documented in the project area in subunits 1-5, 3-3, 5-1, and 6-3. Potential habitat within the treatment area is 512,178 acres of ponderosa pine and 25,658 acres of pinyon-juniper.
Pale Townsend's Big-Eared Bat ***(****Corynorhinus townsendii pallescens****)***	A 2007 bat roost inventory and monitoring project documented Townsend's big-eared bats on both the Kaibab and Coconino NFs (Solvesky and Chambers 2007). Pale Townsend's are known to occur within the project area (subunits 4-3, 5-2, 3-3, 1-3, and 3-5). They use a wide range of habitats, including ponderosa pine forest. Potential habitat includes 512,178 acres of ponderosa pine and 48,774 acres of grassland within the treatment area. There are 34 caves within 300 feet of the treatment area boundary. A 300-foot buffer around cave entrances and sinkhole rims is a design feature applicable to all action alternatives.
Greater Western Mastiff Bat *(Eumops perotis californicus)*	The range for this bat includes all Arizona counties, except Yavapai, Navajo, Apache, and Santa Cruz. A specimen was collected after death near Flagstaff in 1992. They have been documented roosting in the Grand Canyon and foraging across the Kaibab Plateau over 25 miles from the project area. Potential habitat within the project area is 512,178 acres of

Common (Scientific Name)	Species or Habitat Occurrence in Project Area
	ponderosa pine and 48,774 acres of grassland habitat. There are no known roost locations on the Coconino NF or the south zone of the Kaibab NF, although roost habitat may occur on or near the Tusayan district (RU 6) (Solvesky, pers. comm. 2008). The bat is not considered a sensitive species on the Kaibab NF.
Reptiles (1)	
Narrow-headed Garter Snake *(Thamnophis rufipunctatus)*	On the Coconino NF, narrow-headed garter snakes are currently known from Oak Creek Canyon and a few sightings from the Verde River, approximately 5 and 8 miles respectively from the project area. Population numbers in Oak Creek Canyon have decreased significantly, particularly in the lower third of the canyon. Since the late 1980s, they have been entirely absent downstream of Oak Creek Canyon. Based on cottonwood/willow and mixed broadleaf riparian habitats, this species is considered a potential resident of all Coconino NF districts. Neither this species nor its habitat occurs on the Kaibab NF. There are no known locations of narrow-headed garter snake within the project area; however, 42 miles of riparian habitat and ephemeral drainages could provide potential habitat. The entire area within subunit 3-5 was considered for potential impacts to downstream habitat in Oak Creek. Their habitat has not been identified on the Kaibab NF and is not considered a sensitive species on the forest.
Plants (9)	
Arizona Bugbane *(Cimicifuga arizonica)*	The plant occupies mesic canyons in the Oak Creek Canyon, West Fork of Oak Creek and its tributaries, and West Clear Creek (Coconino NF). The first two areas are in or near the analysis area boundary. Monitoring for Arizona bugbane has occurred on the Coconino and Kaibab NFs since 1993. See table 7 in the botany report for the plant site location in relation to 16 past treatments.
Rusby Milkvetch (*Astragalus rusbyi*)	There are numerous occurrences of Rusby milkvetch in the Hart Prairie (2010) and Wing Mountain (2012) projects on the Coconino NF. Occurrences have also been recorded on the Kaibab NF in the Frenchy Project Area (2003) and on the adjacent Camp Navajo (Springer 2009). Coconino Rural Environmental Corps (CREC) (2011) detected numerous locations of this plant in the A-1 Mountain area. Figure 6 and table 8 in the botany report displays occurrences in the project area.
Arizona Leatherflower (*Clematis hirsutissima var. hirsutissima*)	Within the project area, many populations occur near Lower Lake Mary, in Skunk Canyon, and in Fay Canyon. Arizona leatherflower also occurs on the Tusayan district of the Kaibab NF near Ten X Tank (Kaibab NF). Habitat includes rocky hillsides with slopes from 12 to 40 percent with aspects generally from 320 to 40 degrees (Arizona Game and Fish Abstracts 1993). Other scattered populations occur on Harold Ranch Road in east Flagstaff (private land), in Mountainaire (private land), Fort Valley, and near Hoe Tank on the Mogollon Rim district, which is outside the current project area but within ponderosa pine habitat. Table 9 in the botany report displays plant site locations where vegetation and prescribed fire projects have occurred. Prescribed fire projects (Skunk RX Burn), trail projects and grazing would be implemented near known populations and the potential for wildfire would remain. These actions combined with 4FRI actions would continue to affect habitat but none of these actions would lead to a trend toward Federal listing.
Flagstaff Pennyroyal (*Hedeoma diffusum*)	There are two major population areas for this species on the Coconino NF. The first population within the project area extends roughly from Flagstaff, east to Marshall Lake and Fisher point, then south to the vicinity of Mountainaire, then to Lower Lake Mary. A second population area (outside the project area) is near the rim of Oak Creek Canyon and its tributaries (Boucher 1984, Phillips 1984). On the Kaibab NF, it occurs in wilderness and would not be affected by the project. Table 10 in the botany report displays site locations that would be affected by alternatives.

Common (Scientific Name)	Species or Habitat Occurrence in Project Area
Arizona Sneezeweed (*Helenium arizonicum*)	This endemic species ranges from the Mormon Lake area (Coconino NF) southeastward to the White Mountains area where it grows in drainages, near springs, ponds, and other wet areas. This species has been observed in ephemeral drainages in the Upper Lake Mary watershed (Coconino NF). Numerous groups were detected in the Antelope Park area (Coconino NF) by CREC crews in 2011. There are no known locations of Arizona sneezeweed on the Kaibab NF. Table 11 in the botany report documents site locations within project treatment units.
Sunset Crater Beardstongue (*Penstemon clutei*)	The range of this species is limited to the Sunset Crater volcanic field near Flagstaff, including the Coconino NF and Sunset Crater National Monument. There are many locations of Sunset Crater beardtongue in the northeast corner of the project area. Many of these are in treatment units where burning or operational burning would occur. See table 12 in the botany report.
Flagstaff Beardtongue *(Penstemon nudiflorus)*	Flagstaff beardtongue grows in dry pine forests, pine/oak, pine/oak/juniper, and pinyon-juniper forests. It occurs on dry slopes, in openings, and along edges of openings and in forested areas. Table 13 in the botany report documents site locations within project treatment units by alternative.
Blumer's Dock (*Rumex orthoneurus*)	The known distribution of Blumer's dock in the project area is limited to a few enclosures around springs and wet areas. The known occurrences of Blumer's dock within the project area are limited to the Hart Prairie Area, where it shares the habitat with Bebb's willow. There may be other occurrences at other locations in the project area where suitable habitat exists. Documented threats to Blumer's dock include grazing, water diversions, mining, and recreation (USDI 1999).
Bebb's Willow (*Salix bebbiana*	Bebb's willow is a sensitive species for the Coconino NF only. Protection of Bebb's willow was a concern brought up by the public during scoping. The Coconino NF has long recognized the rarity on the landscape for Bebb's willow. The Fern Mountain Botanical Area (established in 1987 in the Coconino forest plan) contains a unique Bebb's willow community. Elsewhere in the project area, Bebb's willows are confined to single plants or groups of plants and the unique Bebb's willow community type is not present. Within the project area, documented locations include the Hart Prairie and Mormon Lake areas on the Coconino NF. There are Bebb's willows in two stands scheduled for treatment in the Mormon Lake area. These include location 435 site 3, which is scheduled for burning only and 454 site 3, which is scheduled to be thinned and burned. Location 454 site 3 is the area surrounding Double Spring which is proposed for spring restoration. Several groups of Bebb's willow occur in the area of Sawmill Spring in location 548 site 3, 704/6, 704/12, 531/7, and 541/13. Many of these plants are dead or decadent and some are heavily browsed. Location 548 site 3 is proposed for channel restoration and operational burning in this project. Location 704 sites 6 and 12 are proposed for thinning and burning accompanied by operation burning. Location 531 site 7 and location 541 site 13 are in a MSO PAC and are proposed for thinning and burning.

Sensitive Species Environmental Consequences

Alternative A Summary of Effects Common to All Forest Sensitive Species

Habitat would remain at high risk from undesirable fire effects from high-severity wildfire (see "Fire Ecology" section). Fire that results in undesirable fire effects could adversely affect potential habitat by removing understory and overstory vegetation and altering soil structure and nutrients. For sensitive plants, these types of changes to the habitat could adversely affect habitat and populations by damaging soil, killing existing plants, and reducing or destroying seed banks. Springs and ephemeral channels would continue to exhibit downward trends in functional condition or remain in static condition for the foreseeable future (see water quality and riparian report) which could degrade existing and potential habitat. Lack of movement toward historic conditions could result in reduced food and reproductive sites and reduced habitat connectivity. Trees would continue to encroach on habitats and understory biomass would continue to decline over the next 40 years (see wildlife report, appendix 8). Increased trees and reduced understory biomass would impact cover and forage, reducing the quantity and quality of habitats, and increasing predation potential.

In terms of nesting and roosting habitat, tree densities—as measured by percent maximum SDI—would continue to be in the high to extremely high density range, slowing growth rates and, thereby, limiting the development of larger diameter (≥ 18-inch) trees and snags, both of which are important for nesting and roosting.

Alternative A Cumulative Effects

For semiaquatic species such as the northern leopard frog, degradation of habitat facilitated by this alternative would cumulatively combine with other forest activities, high impact recreational use, livestock grazing, habitat loss, and degradation on private lands and climate change, and would continue to fragment key aquatic and dispersal habitat.

For terrestrial species, birds, and insects, degradation and fragmentation of habitat would cumulatively combine with other forest activities, high impact recreational use, livestock grazing, use of nonjurisdictional roads, habitat loss and degradation on private lands, and climate change would continue to fragment key nesting and foraging habitat. Prescribed fire treatments in adjacent projects and grazing may result in short-term impacts to habitat, but these are not expected to result in long-term cumulative impacts and are expected to be localized in nature. Continued dense forest conditions would limit the growth and sustainability of large trees slowing development of potential roost areas. Other activities including utility line and road reconstruction and maintenance, high-impact recreation, and climate change would combine to result in degradation of nesting and roosting habitat. See table 71 for the cumulative effects baseline and assessment of ongoing and reasonably foreseeable actions.

For all sensitive plants, alternative A results in the potential for severe effects from wildfire that could adversely affect the habitat and populations by damaging soil, killing existing plants, and by reducing or destroying the seed bank. Noxious or invasive weeds would increase and contribute to degradation of the habitat and loss of individuals and populations.

Alternatives B, C, and D Summary of Effects

See table 71 for the effects and sensitive species effects determinations for alternatives B, C, and D.

Table 71. Alternatives B, C, and D sensitive species environmental consequences determination

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
Amphibians	
Northern Leopard Frog	Mitigations measures would reduce the likelihood of direct impacts to frogs from mechanical thinning, temporary road construction, spring, seep and ephemeral drainage restoration, road decommissioning, prescribed fire, and the spread of chytrid fungus. Seventy-four springs/seeps would be restored, with 32 of those in RU 1, which contains all critical and potential breeding sites. Restoration would increase riparian vegetation increasing availability of food and reproductive sites over the long term, resulting in direct beneficial effects to habitat. Twenty-four miles of ephemeral streams would be restored in RU 1 resulting in improved cover and waterflow that provides escape from predators and prevents water loss for migrating leopard frogs. Spring and channel restoration would result in short-term disturbance to vegetation during implementation. Restored vegetation would be expected to recover within a 1- to 3-year period (soil report). Approximately 127 acres of breeding and dispersal habitat would be impacted by road reconstruction. About 615 acres of forested habitat may be improved within breeding and dispersal habitat. Constructing 71 miles of temporary roads would temporarily disturb vegetation and reduce habitat quality for leopard frogs. **In all alternatives** the likelihood of large high-severity wildfires adversely affecting potential habitat by destroying understory and overstory vegetation would be reduced in RU 1 by 37 percent in ponderosa pine and 5 percent in grasslands. **Specific to alternative C**: The installation of 15 weirs in drainages within RUs 1, 3, and 5 could potentially act as barriers and limit the ability to occupy additional areas. The alternative results in the greatest response in understory (wildlife report, appendix 8) and increases the likelihood of successfully foraging around and migrating between livestock tanks due to decreased risk of predation. The likelihood of large high-severity wildfires adversely affecting potential habitat by destroying understory and overstory vegetation would be reduced in RU 1 by 37 percent in ponderosa pine and 18 percent in grasslands. **Specific to alternative D**: The lowest response of understory biomass occurs. It would result in less cover reducing the likelihood of successfully foraging around and migrating between livestock tanks due to increased risk of predation. The lack of burning further limits understory response, however, the reduction of prescribed fire could reduce direct impacts to frogs migrating overland between stock tanks. The likelihood of large high-severity wildfires adversely affecting potential habitat by destroying understory and overstory vegetation would be reduced in RU 1 by 32 percent in ponderosa pine and 1 percent in grasslands. **Cumulative Effects**: Direct impacts from mechanical thinning, temporary road construction, prescribed fire, and other restoration activities would combine with ongoing activities that have similar effects. Current, ongoing, and reasonably foreseeable projects listed in appendix 12 of the wildlife report include fuels reduction, forest health, aspen regeneration, tornado rehabilitation, and powerline development and maintenance. Cumulatively, activities are not expected to result in long-term effects and are expected to be localized in nature. **Effects Determination**: **Implementation of alternatives B, C, and D may impact individuals, but are not likely to cause a trend to Federal listing or loss of viability**.

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
Birds	
Bald Eagle	Direct effects would be from activities that cause disturbances (smoke, auditory, or visual) to bald eagles nesting or foraging within or adjacent to the project. There would be no direct adverse effects to nesting eagles as project design features would eliminate disturbance near known nesting sites. Subunit 1-3 could have a restricted burning period to reduce smoke impacts to two nests. Specialists reviewed the other nest site on the Kaibab NF and determined it would not be impacted from smoke. There would be no effect to nesting or roosting eagles, however, short-term disturbance to foraging bald eagles would occur during mechanical treatments, prescribed fire, hauling of timber, and other project activities which may cause visual or auditory disturbance to foraging bald eagles. Disturbance would be localized and of short duration, and may affect individual birds but would not affect the overall distribution or reproduction of the species. There are no anticipated adverse effects to prey species or prey species habitat. Thinning would improve old tree longevity, resulting in beneficial effects. Snags used by bald eagle would slightly increase post treatment (2020) and continue to increase in the long term. **Alternative D** would provide 5 percent less developing old growth in the short term (post treatment) and 5 percent less long term (30 years post treatment) compared to **alternatives B and C.** **Cumulative Effects**: Current, ongoing, and reasonably foreseeable projects are listed in appendix 12 of the wildlife specialist report and include fuels reduction, forest health, aspen regeneration, tornado rehabilitation, and powerline development and maintenance. Implementation of other project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. All alternatives would improve and develop quality potential nesting and roosting habitat by developing groups of large trees and snags that are more fire resilient. This positive effect would be combined with similar effects from activities such as the travel management efforts that may decrease the frequency of disturbance on the majority of potential roost sites, slightly counteracting the effects of utility line and road construction and maintenance, and short-term disturbances from vegetation management and prescribed fire. **Effects Determination**: **Alternatives B, C, and D may impact individuals, but are not likely to cause a trend to Federal listing or loss of viability**.
American Peregrine Falcon	About 816 acres of habitat would be impacted by road reconstruction. Springs and channel actions would improve habitat. There would be short-term disturbance to vegetation during implementation but restored vegetation would be expected within a 1-year period. About 2,712 acres of forested habitat would be positively affected from road decommissioning. Eliminating disturbance along roadways would be expected to improve the quality of habitat in the long term. Constructing temporary roads would temporarily disturb vegetation and potentially reduce available habitat on 1,671 acres for peregrine prey. Use of these roads by machinery and equipment could crush animals moving across the road. These effects may impact individuals but are expected to be short term, occurring only during project implementation. Vegetation would be restored over the long term. No direct effects from mechanical treatments, temporary road construction, prescribed fire, or spring and riparian habitat and ephemeral streams restoration is expected due to eyrie locations (cliff ledges in rugged canyons). Activity disturbances would be localized, of short duration, and low intensity, and may affect individual birds but would not affect the overall distribution or reproduction of the species. Restoring habitats toward historic conditions and increasing water yield across the forest to improve marsh, pond, or lake habitat can increase prey base for peregrine falcons, resulting in an indirect beneficial effect. **Specific to alternative C:** Increased acres of grassland restoration would have a greater beneficial effect to peregrine prey. Constructing 15 weirs that would impact 3 acres would not have a discernible impact to prey species habitat at the project level.

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
	Specific to alternative D: The alternative produces the lowest response of understory biomass. The reduced understory biomass would result in fewer habitats for peregrine prey. **Cumulative Effects:** Other present and reasonably foreseeable projects are listed in appendix 12 of the wildlife specialist report. Those projects where thinning and burning occurs could affect the prey base on a short-term basis by impacting individuals of prey species due to disturbance of prey species' habitat and harm from fire. However, projects would be implemented at different times and/or different locations, thus disturbances to the prey base would be minimized. Other past, present, and ongoing projects have implemented thinning (2,304 acres) and prescribed fire (8,951 acres) in grasslands and prescribed fire (11 springs) and mechanical treatment (6 springs) improving habitats for peregrine prey species in the long term. **Effects Determination**: **Alternatives B, C, and D may impact individuals, but are not likely to cause a trend to Federal listing or loss of viability**.
Clark's Grebe	There would be no direct effects to Clark's Grebe eggs, young, or adults from mechanical treatment and/or prescribed fire. Management in adjacent ponderosa pine, grasslands, and ephemeral drainages could indirectly affect habitat by increasing water yield and improving marsh, pond, and lake habitats increasing availability of food and reproductive sites for these species over the long term, resulting in direct beneficial effects to habitat. **In alternative C**, the research areas are not located within subunits where grebe habitat exists. **Cumulative Effects:** Thinning and prescribed fire have occurred in both ponderosa pine and juniper with projects such as Anderson Mesa Prescribed Burn, Lake Mary, Elk Park and Mormon Lake Basin Fuels Reduction and Forest Health projects, and Picket Agra Ax reducing tree densities potentially increasing water yield into grebe's habitat. Implementation of BMPs would curtail soil erosion and minimize potential for inflow into potential Clark's grebe habitat. Impacts from livestock grazing and increased drought from climate change are expected to be somewhat decreased by a reduction of tree densities increasing water yield into grebe's habitat. **Effects Determination**: **Alternatives B, C, and D would have no impact to the Clark's grebe.**
Burrowing Owl (Western)	There are no documented nesting burrowing owls in the project area, however, potential nesting habitat does exist. Direct effects could occur if motorized equipment runs over aboveground nests or burrows. While 10 to 15 percent of the immediate area in grasslands may be disturbed in the short term, the area is expected to quickly be covered with new needle duff and improved herbaceous vegetative cover and improved soil productivity in the longer term (more than 2 years) (soil resources report). Indirect effects include effects to owl habitat, owl prey species, or prey species habitat. Restoring habitats toward historic conditions could increase potential nesting and foraging habitats. Meadow restoration would improve and increase available habitat for prairie dogs, which would provide nesting habitat for owls. Treatments would increase available habitat for prairie dogs with 11,185 acres of grassland restoration. Prescribed fire would remove cover and food. However, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats for insects and small mammals, increasing food sources and resulting in an indirect beneficial effect. **Specific to alternative C**: Decreases tree encroachment in grasslands by treating 48,206 more acres of grassland, thus decreasing impacts to the larger prairie dog population. Treatments would occur within open linkages providing additional opportunities for Gunnison's prairie dogs to colonize new areas and recolonize areas where trees have encroached previously occupied habitat in Government and Garland Prairie, Kendrick Park, and other grasslands. Alternative C treats the most acres and elicits the greatest response in understory (appendix 8 of the wildlife report). As a result, the habitat as a whole would be more likely to support a greater prairie dog population in grassland systems in the project area, thus supporting more potential owl habitat.

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
	Specific to alternative D: The alternative does not include prescribed fire across the mechanical treatments and there are about 20,645 fewer acres of prescribed fire only, further limiting understory response. This alternative provides the least amount and lowest quality of habitat for prairie dogs hence less habitat for burrowing owls. **Cumulative Effects**: Activities such as implementation of the travel management decisions are likely to decrease motorized use in grasslands, thus decreasing impacts to prairie dog populations. This, combined with forest restoration activities, could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving prairie dog colonies. Past, present, and reasonably foreseeable projects are listed in appendix 12 of the wildlife specialist report. Past projects have implemented thinning on 2,304 acres and prescribed fire on 8,951 acres in grasslands. Short-term and localized effects from mechanical thinning and prescribed fire would result in the potential collapsing of burrows and displacement of prairie dogs. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire, and wildfire suppression activities to temporarily displace prairie dog populations (and, thus, burrowing owls) in a limited area. The thinning of 2,304 acres and prescribed fire on 8,951 acres in grasslands would add to the acres of treatments in this project to reduce tree densities in grasslands and connect open corridors across the analysis area providing additional potential habitat for burrowing owls. **Effects Determination**: **Alternatives B, C, and D would have no impact to burrowing owls**.
Ferruginous Hawk	There are no direct effects to ferruginous hawks as none are known to nest in the project area. Indirect effects to the ferruginous hawk include effects to prey species or prey species habitat. **Alternative B**: While 10 to 15 percent of the immediate area in grasslands and 10 to 20 percent in savanna may be disturbed in the short term, grasslands are expected to quickly be covered with new needle duff and improved herbaceous vegetative cover in the longer term (more than 2 years). Savanna restoration would increase available habitat for prairie dogs with 11,185 acres of meadow and 45,469 acres of savanna treatments, resulting in an indirect beneficial effect. Project activities may cause visual or auditory disturbance to foraging ferruginous hawks; however, these are short-term effects and would be minimized due to activities being temporally and spatially separated. This disturbance would be localized, of short duration and low intensity, and may affect individual birds but would not affect the overall distribution or reproduction of the species. **Alternative C** treats the most acres and elicits the greatest response in understory. This would improve habitat for ferruginous hawks prey species. **Alternative D** provides the least amount and lowest quality of habitat for prey species, hence less habitat for ferruginous hawks. **Cumulative Effects**: Past, present, and reasonably foreseeable projects are listed in appendix 12 of the wildlife specialist report. Past projects have implemented thinning on 2,304 acres and prescribed fire 8,951 acres in grasslands. Short-term and localized effects from mechanical thinning and prescribed fire would result in the potential collapsing of burrows and displacement of prairie dogs. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire, and wildfire suppression activities to temporarily displace prairie dog populations (and, thus, ferruginous hawks) in a limited area. The thinning of 2,304 acres and prescribed fire on 8,951 acres in grasslands would add to the acres of treatments in this project to reduce tree densities in grasslands and connect open corridors across the project area providing additional potential habitat for ferruginous hawks. **Effects Determination**: **Alternatives B, C, and D would have no impact to ferruginous hawks.**

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
Insects	
Four-spotted Skipperling	Under **alternative B**, approximately 74 springs would be restored on potential habitat. There would be short-term disturbance to vegetation during implementation of stream and spring restoration projects; however, restored vegetation would be expected to recover within a 1- to 3-year period (soil resources report). Indirect effects from mechanical treatments, temporary road construction, and prescribed fire would disturb or remove understory vegetation, in effect reducing availability to adult butterflies and/or caterpillars. However, these would be short-term effects and would be minimized due to activities being temporally and spatially separated. Moving these habitats toward historic conditions could increase heterogeneity providing both direct habitat connectivity and habitat stepping stones facilitating landscape movement. **In alternative C**, the overall increase in grassland treatments would have a greater beneficial impact on the development of understory vegetation, increasing availability of food and reproductive sites and improving habitat connectivity resulting in indirect beneficial effects. **In alternative D,** the understory response is not anticipated to be as robust due to the lack of prescribed fire after mechanical treatments. **Cumulative Effects**: Cumulative activities such as implementation of travel management decisions are likely to decrease motorized use in grasslands and meadows, thus decreasing impacts to butterfly habitat. This combined with forest restoration activities could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving butterfly populations. Short-term and localized effects from mechanical thinning, temporary road construction, and prescribed fire would result in the temporary reduction of understory vegetation reducing plant availability to adult insects, a primary food source. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire and wildfire suppression activities, ungulate grazing, and drought from climate change to temporarily displace butterflies in a limited area. **Effects Determination**: **Alternatives B, C, and D may impact the four-spotted skipperling, but are not likely to cause a trend to Federal listing or loss of viability.**
Nitocris Fritillary	Approximately 47 springs and 32 miles of ephemeral streams would be restored in potential habitat on the Coconino NF. The impacts and benefits associated with springs and stream restoration and indirect effects of other activities would be the same as described above for the four-spotted skipperling. C**umulative Effects:** Past, present, and reasonably foreseeable projects are listed in appendix 12 of the wildlife report and include projects within wet areas within the ponderosa pine, springs, and wet meadows. Past activities within springs, wet meadows, and riparian streams have been limited with mechanical treatments implemented on three springs and 1.3 miles of riparian habitats and prescribed fire on eight springs and 2.8 miles of riparian habitats. There are 44 springs within a half mile of the project boundary that may be improved through current and reasonably foreseeable projects that reduced tree densities and increased understory vegetation improving functional condition. These projects would combine with this forest restoration project to improve habitat for nitocris fritillary. The cumulative effects are the same as described for the four-spotted skipperling. **Effects Determination**: **Alternatives B, C, and D may impact the nitocris fritillary, but are not likely to cause a trend to Federal listing or loss of viability**.

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
Nokomis Fritillary	Approximately 51 springs/seeps and 85 miles of ephemeral streams would be restored in potential habitat. The impacts and benefits associated with springs and stream restoration, and indirect effects of other activities would be the same as described above for the four-spotted skipperling. **Cumulative effects** are the same as described above for nitocris fritillary. **Effects Determination**: **Alternatives B, C, and D may impact the Nokomis fritillary, but are not likely to cause a trend to Federal listing or loss of viability.**
Mammals	
Navajo Mogollon Vole	Under alternative B, thinning and prescribed fire activities may disturb individual voles, resulting in direct adverse effects. Prescribed fire would result in the removal of cover and food; however, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Such activities would occur across the project area at different times; thereby reducing impacts to this species. In addition, the effect would be short term and would have no impact to the population viability of voles. The potential for high-severity fire within grasslands would be slightly (1 percent) reduced with a greater reduction in ponderosa (34 percent) (fire ecology report). Decommissioning of roads means more snags would be available in the future within vole habitat. Springs (74) and ephemeral stream channel restoration (39 miles) would have short-term disturbance to vegetation limiting habitat for the vole; however vegetation would be expected to recovery within a year, increasing availability of food for small mammals over the long term, resulting in indirect beneficial impacts. **Alternative C** adds 48,206 acres of grassland restoration treatments and restores larger grasslands such as Garland and Government Prairie where voles are known to occur. In **alternative D**, the lack of prescribed fire after thinning treatments would deteriorate patterns of surface vegetation, as shrubs and other species adapted to fire decline (Huffman and Moore 2004, Moir 1988). Landscape patterns and mosaics that would have been created or maintained with fire would have to be maintained mechanically. The lack of fire means no nutrient pulse into the system, further limiting understory response. **Cumulative Effects**: Activities that impact the vole include fuels reduction, forest health, aspen regeneration, tornado rehabilitation, and powerline development and maintenance. Past and ongoing grassland activities include 8,951 acres of prescribed fire and 2,034 acres of mechanical treatments. Short-term impacts added to similar impacts from nearby projects were considered. Implementation of other project activities could occur simultaneously, however, it is not anticipated to combine to cause a negative effect. All alternatives could increase potential habitat quality and quantity and reduce risk of uncharacteristic, high-severity wildfire. This positive effect would be combined with similar effects from activities such as implementation of the travel management efforts that may decrease the frequency of disturbance on the majority of potential roost sites, slightly counteracting the effects of utility line and road reconstruction and maintenance, and short-term disturbances from vegetation management and prescribed fire. Short-term and localized effects from mechanical thinning, temporary road construction, and prescribed fire would result in the temporary reduction of understory vegetation and soil compaction. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire and wildfire suppression activities, ungulate grazing, and drought from climate change to alter availability of both food and cover for voles and temporarily displace voles in a limited area. Livestock are managed in systems designed to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects. However wild ungulates would continue to reduce vegetative understory and affect plant composition. **Effects Determination**: **Alternatives B, C, and D may impact the Navajo Mogollon vole, but are not likely to cause a trend to Federal listing or loss of viability.**

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
Long-tailed Vole	The direct and indirect effects are the same as described for the Navajo Mogollon vole. **Cumulative Effects**: Past, present, and reasonably foreseeable projects considered are listed in appendix 12 of the wildlife report and include projects within springs, seeps, riparian areas, and streams. Past activities within springs, riparian areas, and streams have been limited with mechanical treatments implemented on 11 springs, 50 acres of riparian areas, and 1.3 miles of riparian streams, and prescribed burning on 6 springs, 17 acres of riparian areas, and 2.8 miles of riparian streams. There are 44 springs within a half mile of the project boundary that may be improved through current and reasonably foreseeable projects that reduced tree densities and increased understory vegetation, improving functional condition. These projects would combine with this forest restoration project to improve habitat for long-tailed vole. Other past, present, and ongoing projects have implemented thinning on 2,304 acres and prescribed fire on 8,951 acres in grasslands, improving habitats for long-tailed vole in the long term. The action alternatives results in impacts that may combine cumulatively with other forest and nonforest activities including wildfire and wildfire suppression activities, livestock grazing, recreation, and increased temperatures and predicted vegetation shifts at higher elevations from climate change. All these activities result in impacts by affecting vole habitat and potentially directly affecting vole burrows. The action alternatives would have a much larger beneficial cumulative effect from meadow, grassland, and ponderosa pine restoration treatments. This change, combined with reduced motorized use within these areas, would result in less disturbance and fragmentation to vole habitat. **Effects Determination**: **Alternatives B, C, and D may impact the long-tailed vole, but are not likely to cause a trend to Federal listing or loss of viability**.
Dwarf Shrew	Thinning and prescribed fire activities may disturb individual shrews, resulting in direct adverse effects. Using prescribed fire would result in the removal of cover and food. The effect would be short term. Meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Activities would occur across the project area at different times; thereby reducing impacts to this species. There would be no effects to population viability of shrews. Spring and ephemeral channel restoration would improve riparian vegetation, increasing availability of food for small mammals over the long term, resulting in indirect beneficial impacts. **Cumulative Effects:** Cumulative activities such as implementing travel management are likely to decrease motorized use in grasslands and meadows, thus decreasing impacts to shrew habitat. This, combined with forest restoration activities, could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving small mammal populations. Short-term and localized effects from mechanical thinning, temporary road construction, and prescribed fire would result in the temporary reduction of understory vegetation. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire and wildfire suppression activities, ungulate grazing, and drought from climate change to temporarily displace shrews in a limited area. Climate change is also expected to result in a higher frequency of high-severity wildfires (Marlon et al. 2009) and prolonged periods of drought (Furniss et al. 2010), which would also cumulatively contribute to decreases in vegetative ground cover. **Effects Determination**: **Alternatives B, C, and D may impact the dwarf shrew, but are not likely to cause a trend to Federal listing or loss of viability**.
Merriam's Shrew	The direct and indirect effects are the same as described for the dwarf shrew with the following additions. Indirect benefits could potentially result from restoring meadows encroached by pine trees and reducing uncharacteristic tree densities and patterns in the ponderosa pine forest resulting from fire exclusion. These efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit Merriam's shrew and their prey. Coarse woody debris would increase slightly in the short term and would continue to increase over the long term. Exclosures around restored spring and ephemeral channels would

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
	improve riparian vegetation, increasing availability of food for small mammals over the long term, resulting in indirect beneficial impacts. **Cumulative Effects:** Current, ongoing, and reasonably foreseeable projects are listed in appendix 12 of the wildlife report and include fuels reduction, forest health, aspen regeneration, tornado rehabilitation, and powerline development and maintenance. Cumulative activities such as implementing travel management are likely to decrease motorized use in grasslands and meadows, thus decreasing impacts to shrew habitat. This combined with forest restoration activities could open up more habitats or provide more contiguous swaths of grassland habitat key to supporting thriving small mammal populations. Short term and localized effects from mechanical thinning, temporary road construction, and prescribed fire would result in the temporary reduction of understory vegetation. This impact may combine with short-term cumulative impacts from localized dispersed camping, wildfire and wildfire suppression activities, ungulate grazing, and drought from climate change to temporarily displace shrews in a limited area. Development of private and State land has the greatest potential impact to shrew habitat. **Effects Determination: Alternatives B, C, and D may impact the Merriam's shrew, but are not likely to cause a trend to Federal listing or loss of viability.**
Western Red Bat	In alternatives B, C, and D, thinning and prescribed fire could potentially disturb red bats if they are roosting in trees or hibernating among leaf litter. However, most prescribed fire would occur in the spring and fall and burn plans within a half mile of known roosts/hibernacula would be designed to limit smoke at critical times (April through July and mid-winter). Actions are expected to result in a slight short-term decrease in snags followed by an increase over the long term. This short-term loss of snags is not expected to affect the overall distribution of western red bats on the forest. Prescribed fire after mechanical treatments would result in the removal of cover and food; however, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats, thereby enhancing prey habitat. Restoring openings and edge habitat within the forest and improving understory vegetation would benefit western red bats and their prey. Moving these habitats toward historic conditions would also increase resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire. Spring and ephemeral channel restoration would improve riparian vegetation, increasing availability of food for prey species over the long term, resulting in indirect beneficial effects. **Cumulative Effects**: These short-term impacts added to similar impacts from other past, present, and reasonably foreseeable projects were considered. Implementation of other fuel reduction project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally, grazing systems are managed on a rotational grazing system to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. However, wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around waters. **Effects Determination**: **Alternatives B, C, and D may impact the western red bat, but are not likely to cause a trend to Federal listing or loss of viability**.
Spotted Bat	Under **alternative B,** thinning and prescribed fire activities could potentially disturb spotted bats if they are roosting in rock crevices within the ponderosa pine treatment area. Prescribed fire occurring when bats are rearing young (April through July) or in deep hibernation (mid-winter) can have negative effects on local populations. However, most prescribed burning would occur in the spring and fall and burn plans within a half mile of caves, mines, or cliff habitats would be designed to limit smoke at critical times (April through May and mid-winter). Other effects from prescribed fire are the same as described for the greater western mastiff bat.

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
	Alternative C treats the most acres and elicits the greatest response in understory and the greatest availability of food for bats. **Alternative D** produces the lowest response of understory biomass of all the action alternatives limiting prey and resulting in indirect adverse effects to spotted bat. **Cumulative Effects**: Current, ongoing, and reasonably foreseeable projects are listed in appendix 12 of the wildlife report and include fuels reduction, forest health, aspen regeneration, tornado rehabilitation, and powerline development and maintenance. Past and ongoing grassland activities include 8,951 acres of prescribed fire and 2,034 acres of mechanical treatments. There may be potential short-term disturbance to potential foraging and roosting habitat with long-term benefits. Short-term disturbance to bats would occur during thinning, hauling, and prescribed fire activities and may cause disturbance in nearby areas for the duration of the activity. These short-term impacts added to similar impacts from other past, present, and reasonably foreseeable mechanical vegetation management and fuels reduction projects were considered. Implementation of other vegetation management and fuel reduction project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally, grazing systems are managed on a rotational grazing system to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. However wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around waters. **Effects Determination: Alternatives B, C, and D may impact spotted bat, but are not likely to cause a trend to Federal listing or loss of viability.**
Allen's Lappet-browed Bat	In **alternatives B, C, and D**, thinning and prescribed fire activities could potentially disturb Allen's lappet-browed bats if they are roosting in trees within the ponderosa pine and pinyon-juniper treatment areas. Prescribed fire occurring when bats are rearing young (April through July) or in deep hibernation (mid-winter) can have negative effects on local populations. However, most prescribed fire would occur in the spring and fall, and burn plans within a half mile of known roosts/hibernacula or unsurveyed caves and mine shafts would be designed to limit smoke at critical times (April through May and mid-winter). Prescribed fire may also result in the loss of individual snags which could affect roosting bats; however, mitigation including managing for retention of all snags 18 inches in diameter and greater would reduce the impact. The alternatives are expected to result in a slight short-term increase in snags followed by a continuing increase over the long term. Prescribed fire would result in the removal of cover and food; however, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial impacts to bats. Forest conditions after treatment would improve bat habitat within the project area. Increasing diversity and density of understory vegetation provides habitat for prey population. Treatments would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit Allen's lappet-browed bats and their prey. Moving these habitats toward historic conditions would also increase resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire. Decommissioning of roads means more snags would be available in the future within Allen's lappet-browed bat habitat providing more roosting structures. Spring and channel restoration would improve riparian vegetation, increasing availability of food for bats over the long term, resulting in indirect beneficial effects. **Cumulative Effects:** Cumulative effects are the same as described above for the western red bat with one addition. Implementation of the travel management decisions has reduced the number of roads near Allen's lappet-browed bat roost locations.

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
	Effects Determination: **Alternatives B, C, and D may impact Allen's lappet-browed bat, but are not likely to cause a trend to Federal listing or loss of viability.**
Pale Townsend's Big-Eared Bat	The direct and indirect effects of **alternatives B, C, and D** are the same as described above for the western red bat with the following additions: The proposed decommissioning of roads means more snags would be available in the future within Townsend's big-eared bat habitat providing more roosting structures. Spring and channel restoration would improve riparian vegetation, increasing availability of food for Noctuids and, therefore, Townsend's big-eared bat over the long term, resulting in indirect beneficial impacts. In **alternative C**, the overall increase in grassland treatments would have a beneficial impact on Townsend's big-eared bat prey resulting in indirect beneficial effects. **Alternative D** produces the lowest response of understory biomass of all the action alternatives limiting prey and resulting in indirect adverse effects to Townsend's big-eared bat. **Cumulative Effects**: Past and ongoing grassland activities include 8,951 acres of prescribed fire and 2,034 acres of mechanical treatments. Short-term impacts added to similar impacts from other past, present, and reasonably foreseeable projects were considered. Implementation of other fuel reduction project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally, grazing systems are managed on a rotational grazing system to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. However, wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around waters. Travel management implementation has reduced the number of roads near Townsend's big-eared bat roost locations. **Effects Determination**: **Alternatives B, C, and D may impact pale Townsend's big-eared bat, but are not likely to cause a trend to Federal listing or loss of viability.**
Greater Western Mastiff Bat	Disturbance from thinning and prescribed fire activities would be highly unlikely. In addition, direct effects to roosting from project implementation are not anticipated. Prescribed fire would result in the removal of cover and food; however, it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Indirect effects would result from vegetation modification activities such as thinning and prescribed fire. These activities would disturb or remove understory vegetation, subsequently reducing availability to insects. These effects would be short term and would be minimized due to activities being temporally and spatially separated. Efforts would aid in restoring openings and edge habitat within the forest and improving understory vegetation that would benefit greater western mastiff bats and their prey. Moving these habitats toward historic conditions would also increase resilience of these habitats and decrease the risk of uncharacteristic, high-severity wildfire. Exclosures around restored spring and ephemeral channels would improve riparian vegetation, increasing availability of food for bats over the long term, resulting in indirect beneficial impacts. **Alternative C** treats the most acres and elicits the greatest response in understory and the greatest availability of food for bats. **Alternative D** produces the lowest response of understory biomass limiting prey and resulting in indirect adverse effects to greater western mastiff bat. **Cumulative Effects**: Current ongoing and reasonably foreseeable projects are listed in appendix 12 of the wildlife report and include fuels reduction, forest health, aspen regeneration, tornado rehabilitation, and powerline development and maintenance. Past and ongoing grassland activities include 8,951 acres of prescribed fire and 2,034 acres of mechanical treatments. There may be potential short-term disturbance to potential foraging and roosting habitat with long-term benefits. Short-term disturbance to bats would occur during thinning, hauling, and prescribed

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
	fire activities and may cause disturbance in nearby areas for the duration of the activity. These short-term impacts added to similar impacts from other past, present and reasonably foreseeable projects were considered. Implementation of other fuel reduction project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Generally, grazing systems are managed on a rotational grazing system to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. However wild ungulates would continue to reduce vegetative understory and affect plant composition in meadows and around waters. **Effects Determination**: **Alternatives B, C, and D may impact greater western mastiff bat, but are not likely to cause a trend to Federal listing or loss of viability.**
Reptiles	
Narrow-headed Garter Snake	There would be no direct effects to narrow-headed garter snakes from mechanical treatment and/or prescribed fire. The project would not be directly treating the habitat. Treatments in subunits connected to these watersheds could potentially lead to increased sedimentation and/or ash flow into narrow-headed garter snake habitat (see aquatic species and watershed reports). However, this increase in sediment or ash over background levels would not have negative impacts on habitat for this species. Conversely, moving the forested uplands toward historic conditions would increase resilience of these systems and decrease the risk of uncharacteristic, high-severity wildfire. Protective stream buffer strips would be employed along the Sterling Canyon stream course for both alternatives B and C to reduce the risk of sediment and ash flow into Upper Oak Creek. Spring restoration would increase riparian vegetation increasing availability of food and reproductive sites for these species over the long term, resulting in direct beneficial effects to habitat. In alternative D, there would be no prescribed fire on slopes greater than 15 percent along the upstream portion of Oak Creek within subunit 3-5, eliminating the need for a protective stream course buffer along the entire length of Sterling Canyon. **Cumulative Effects**: The area analyzed for cumulative effects for narrow-headed garter snake is subunit 3-5. No cumulative effects to narrow-headed garter snake would occur from implementing any of the alternatives, when added to past, present, and reasonably foreseeable future activities. Ongoing and foreseeable future projects include tornado rehabilitation and the Turkey Barney Fuels Reduction and Forest Health project. Implementation of other projects could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. BMPs are implemented for all projects and would curtail soil erosion and minimize potential for inflow into potential narrow-headed garter snake habitat. **Effects Determination: Implementation of alternatives B, C, and D may impact narrow-headed garter snake, but are not likely to cause a trend to Federal listing or loss of viability.**
Plants	
Arizona Bugbane	Mitigation applicable to alternatives B, C, and D would protect shady, mesic microclimate needed for survival and reproduction and reduce risk associated with increased noxious or invasive weeds. **Cumulative Effects:** The cumulative effects boundary is the range of Arizona bugbane within the Coconino and Kaibab NFs. The time limit is from the year 2000 to present. Past impacts include grazing, recreation, wildfire, and natural disturbances such as flooding, drought, tornados, and mortality in overstory trees. Natural events have affected the habitat and distribution of Arizona bugbane in some areas. Ongoing and foreseeable vegetation projects have treatments similar to 4FRI. Impacts to ongoing and foreseeable impacts (vegetation projects, grazing) are mitigated by treatment design; therefore, the cumulative effects are nonsignificant.

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
	Effects Determination: Alternatives B, C, and D may impact individuals of Arizona bugbane but are not likely to result in a trend toward Federal listing or loss of viability.
Rusby Milkvetch	**Alternatives B, C, and D** direct effects include the immediate loss of individual plants or population groups through management actions. In the long term, there would be benefits from reduced competition and increased amounts of sunlight and nutrients. Burning is a disturbance that can release nutrients, reduce plant competition, and increase the amount of available sunlight. Survey and mitigation would reduce the risk of increased noxious or invasive weeds and damage or loss from springs, channels, and road activities. **Cumulative Effects**: The cumulative effects boundary is the range of Rusby milkvetch which is confined to the volcanic fields of the San Francisco Peaks, approximately 1,152,000 acres (Priest et al. 2001). Only a portion of this area—the ponderosa pine forest—is suitable habitat. Several large wildfires have occurred in the project area; but cumulatively, this represents less that 5 percent of the available habitat. Implementation of travel management on both forests, combined with such actions as road decommissioning in this project, would reduce the impacts of vehicle traffic in the habitat of Rusby milkvetch. Implementation will continue in projects (such as Hart Prairie, Wing Mountain, Frenchy, and Pomeroy) in the range of Rusby milkvetch. Other actions including grazing and foreseeable trail construction (Mt. Elden, Dry Lake Hills) when combined with 4FRI would continue to occur in the range of Rusby milkvetch and continue to affect it. Cumulatively, none of these actions would lead to a trend toward Federal listing. **Effects Determination**: **Alternatives B, C, and D may impact individuals of Rusby milkvetch but are not likely to result in a trend toward Federal listing or loss of viability**.
Arizona Leatherflower	With mitigation, alternatives B, C, and D direct and indirect effects are similar to those for Rusby milkvetch. **Cumulative Effects:** The temporal timeframe for cumulative effects is 2007 when the species was returned to the Southwestern Region's sensitive species list after being absent from it for nearly 10 years. The cumulative effects boundary is the occupied habitat within the project boundary. Past actions such as grazing, fire suppression, wildfires, timber, recreation, and plant collecting have occurred and have contributed to existing conditions; however, effects of high-severity fire are unknown. Actions on nonforest lands may have affected the occurrence and distribution of Arizona leatherflower in other areas. Many areas in and near Flagstaff that provided potential habitat for the plants have been altered or developed, making the habitat no longer suitable. At least one population on private land was destroyed during a road realignment project. Implementation of travel management combined with project road decommissioning would reduce the impacts of vehicle traffic in the habitat. **Effects Determination: Alternatives B, C, and D may impact individuals of Arizona leatherflower but are not likely to result in a trend toward Federal listing or loss of viability.**
Flagstaff pennyroyal	With mitigation, the direct and indirect effects of alternatives B, C, and D are similar to those discussed for Rusby milkvetch. **Cumulative Effects**: The cumulative effects temporal timeframe is from 2000 to present. The spatial boundary is the range of Flagstaff pennyroyal in the project area including the areas roughly from Flagstaff, east to Marshall Lake and Fisher point, then south to the vicinity of Mountainaire, then to Lower Lake Mary on the Coconino NF, and a limited amount of habitat along the edge of Sycamore Canyon on the Kaibab NF. Activities on nonforest lands in suitable habitat have reduced about 10 percent of the total historical range. The species occurs in several recently analyzed or implemented fuels reduction projects (including Kachina 2003, Mountainaire 2006, Elk Park 2007, see botany report for complete information). These projects covered about 75 percent of the total acreage of the potential habitat managed by the Coconino NF. These projects did not adversely affect the abundance or distribution of Flagstaff pennyroyal

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
	and when combined with the effects of this project, would not adversely affect this species. About 831 acres of prescribed fire would occur (foreseeable) in the Skunk project (Coconino NF) and 20,197 acres would occur on the Eastside project (Coconino NF). In past and foreseeable projects, effects to Flagstaff pennyroyal were mitigated or would be mitigated to nonsignificant levels. Other ongoing and foreseeable actions include dispersed recreation and new motorized trails. When combined with 4FRI actions, there would be no measurable cumulative impact. Any impact would be nonsignificant. Implementation of travel management decisions on both forests, when combined with such actions as road decommissioning in this project, would reduce the impacts of vehicle traffic in the habitat of Flagstaff pennyroyal. **Effects Determination: Alternatives B, C, and D may impact individuals of Flagstaff pennyroyal but are not likely to result in a trend toward Federal listing or loss of viability**.
Arizona sneezeweed	With mitigation, direct and indirect effects to Arizona sneezeweed are similar to those for Rusby milkvetch. **Cumulative Effects**: The cumulative effects temporal timeframe is from 1999 (when the species was added to the Southwestern Region's sensitive species list) to present. The boundary includes the range of Arizona sneezeweed within the project area which is roughly from the Mormon Lake area southward to the project boundary. Past natural events such as persistent drought that began in 1996 and lasted for over 10 years probably affected the abundance and distribution of the species due to its affinity for moist soil. The drought compounded such effects as fire severity and impacts from grazers seeking water sources, which decreased in availability during the drought (see "Climate Change" section for additional information). Alteration of habitat through diversion of water for use to water animals might have also affected the habitat. There have been no past fuels reduction projects in the area where Arizona sneezeweed was documented during surveys. There are no past cumulative effects from actions associated with fuels reduction projects such as tree removal, burning, or road construction and maintenance activities, which are also part of 4FRI. Other ongoing and foreseeable actions include dispersed recreation and new motorized trails. When combined with 4FRI actions, there would be no measurable cumulative impact. Any impact would be nonsignificant. Implementation of travel management decisions on both forests, when combined with such actions as road decommissioning in this project, would reduce the impacts of vehicle traffic in the habitat of Arizona sneezeweed. **Effects Determination: Alternatives B, C, and D may impact individuals of Arizona sneezeweed but are not likely to result in a trend toward Federal listing or loss of viability.**
Sunset Crater Beardstongue	In alternatives B, C, and D, a few units would be treated using the grassland restoration or grassland mechanical prescriptions. In those units, the effects would be similar to mechanical treatment for other species such as Rusby milkvetch. See table 12 in the report which documents site locations within project treatment units by alternative. **Cumulative Effects:** The temporal timeframe for cumulative effects is from 1973 (when the effects of fire to Sunset Crater beardtongue were first noted by a former Coconino NF wildlife biologist) to present. In 1992, a tornado occurred within the habitat and a subsequent salvage sale occurred. Monitoring in 1996 found no adverse effects from the storm or the salvage sale. Two fuels reduction projects (Eastside, 2006 and Jack Smith/Schultz, 2006) are ongoing but are not directly affecting the species due to the small portions of the habitat affected and actions are limited prescribed fire. Several large wildfires have occurred in the habitat: Burnt Fire (1973), Wild Bill Fire (1993), Hochderffer (1996), Cinder Hills Fire (2009), and Schultz Fire (2010). The Schultz Fire caused severe environmental damage including flooding and soil erosion, some of which extended into the habitat. Post-fire rehabilitation actions affected some of the potential habitat. The long-term effects on habitat and native plants include noxious or invasive weed invasion and continued disturbance of the habitat. The cinder hills area that contains most of the habitat is heavily used for recreation (ongoing activity). The Schultz Fire Sediment Reduction Project (2012) is currently being analyzed. Indirect effects include an ongoing source of

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
	disturbance for an indefinite period of time. Continued growth in Doney Park could possibly decrease in the amount of suitable habitat available on nonforest lands. Several utility corridors are present in the potential habitat. The ongoing and foreseeable construction, expansion, and maintenance of these corridors would result in loss of individuals along the corridor routes. Given the baseline condition, ongoing and foreseeable projects/activities, when combined with the 4FRI actions that would affect habitat, would not significantly impact the habitat or the species. **Effects Determination**: **Alternatives B, C, and D may impact individuals of Sunset Crater beardtongue but are not likely to result in a trend toward Federal listing or loss of viability.**
Flagstaff beardtongue	The direct and indirect effects of alternatives B, C, and D to Flagstaff beardtongue are similar to those for Rusby milkvetch with one exception: There are no documented occurrences of Flagstaff beardtongue in areas being analyzed for spring and channel restoration so there would be no direct or indirect effects from those actions. **Cumulative Effects:** The cumulative effects temporal timeframe is from 1999 to present. This represents the length of time that Flagstaff beardtongue has been on the Southwestern Region's sensitive species list. The cumulative effects area is the project boundary. Past fuels projects occurred in approximately 10 percent of the cumulative effects area and did not adversely affect the abundance or distribution of the species. The total acreage of several large fires that have occurred within potential habitat is about 10,500 acres which represents less than 10 percent of the potential habitat. Severe wildfires can potentially destroy plants and alter habitat, but the effects of these fires on Flagstaff beardtongue and its habitat are unknown. Impacts from ungulate grazing in certain areas include past and present loss of individual plants and alteration of habitat through trampling and compaction. Dispersed recreation is an ongoing activity that occurs in the habitat. Several utility corridors are present in potential habitat. Construction, expansion, and maintenance of these corridors would result in loss of individuals along the corridor routes. Implementation of travel management decisions on both forests, when combined with such actions as road decommissioning in this project, would reduce the impacts of vehicle traffic in the habitat. Past, present and foreseeable actions, when combined with 4FRI actions, would have no adverse effects in the short or long term because they would not lead to a significant decrease in habitat or number of plants present in the project area. **Effects Determination: Alternatives B, C, and D may impact individuals of Flagstaff beardtongue but are not likely to result in a trend toward Federal listing or loss of viability.**
Blumer's dock	Alternatives B, C, and D's effects from mechanical treatment, prescribed fire, and road related actions are similar to those described for Rusby milkvetch but are somewhat less important to this species since it is dependent on wet areas for its survival. Direct effects of spring and channel restoration would include deaths of individual plants or population groups during implementation. Management actions such as digging, soil disturbance, and related activities associated with spring restoration may impact individual plants if they are present on the site. These risks would be mitigated by surveying and avoiding plants. Restoration work for springs and channels would benefit the habitat and provide areas for natural generation or reintroduction (see specialist report for examples of past projects where habitat has been improved). The alternatives would reduce fire risk to many understory plants including Blumer's dock. The potential for noxious or invasive weeds would be mitigated (see appendix C of the DEIS). **Cumulative Effects:** The cumulative effects temporal timeframe is from 1991—when the nearby Tonto NF prepared a management plan for Blumer's dock—to the present. Persistent drought in the northern Arizona area that began in 1996 and lasted for over 10 years probably affected the abundance and distribution of Blumer's dock due to its affinity for wet areas. The drought compounded such effects as fire severity and impacts from grazers. Several utility corridors are present in the potential habitat of Blumer's dock. The presence of these corridors provides corridors for dispersal of noxious or invasive weeds along the utility corridor and in

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
	adjacent forested areas. These past events have formed the baseline for the current existing condition. Dispersed recreation is an ongoing activity that occurs in certain areas of the habitat. Management activities that were analyzed as part of the Hart Prairie project (2010) will continue to be initiated including several activities in or near the Hart Prairie Preserve and Fern Mountain Botanical Area. Ongoing activities include construction and/or reconstruction of several enclosures that will provide refugia for Blumer's dock. Construction, expansion, and maintenance of utility corridors would result in loss of individuals along the corridor routes. When alternatives B, C, and D activities are combined with ongoing and foreseeable activities, the result is expected to have minor but beneficial effects to the habitat. **Effects Determination**: **Alternatives B, C, and D may impact individuals of Blumer's dock but are not likely to result in a trend toward Federal listing or loss of viability.**
Bebb's Willow	With mitigation, alternatives B, C, and D's direct and indirect effects for Bebb's willow on the Coconino NF are similar to those for Rusby milkvetch. There are no documented locations of Bebb's willow within the project area on the Kaibab NF, but Bebb's willows may be present in some areas such as around springs and channels. These areas would be surveyed before implementation and mitigation measures and design features would be incorporated as needed into alternatives B, C, and D actions. With survey and mitigation as needed, the direct and indirect effects on Bebb's willow on the Kaibab NF are the same as described above. **Cumulative Effects**: The cumulative effects boundary is the Coconino NF portion of the project area. The temporal timeline is from 1987 (with publication of the "Coconino National Forest Land and Resourece Management Plan") to the present. Cumulative effects to Bebb's willow on the Kaibab NF were excluded from this discussion because there are no documented occurrences in the Kaibab portion of the project and Bebb's willow has no special status on the Kaibab NF. Fern Mountain Botanical Area (186 acres) is dominated by Bebb's willow and represents a unique riparian community. Approximately 1,300 Bebb's willow plants occur in the Hart Prairie area in the botanical area and the Hart Prairie Preserve. Past management actions, including establishment of the botanical area and restoration actions conducted by The Nature Conservancy and the Forest Service, represent the baseline (existing condition) for the species. Management activities that were analyzed as part of the Hart Prairie project (2010) will continue to be initiated including several activities in or near the Hart Prairie Preserve and Fern Mountain Botanical Area. Ongoing activities include construction and/or reconstruction of several enclosures that would provide refugia for Bebb's willow, which would improve the distribution of age classes. The Apache Maid Allotment analysis, which is a concurrent but unrelated analysis, includes the Railroad Spring area. Spring restoration sites in the project may provide locations and opportunities for Bebb's willow restoration. Given the baseline condition, ongoing and foreseeable projects, when considered with 4FRI actions, would be beneficial to habitat and populations. **Effects Determination**: **Alternatives B, C, and D may impact individuals of Bebb's willow but are not likely to result in a trend toward Federal listing or loss of viability.**
Forest Plan Amendments – All Species	Alternatives B, C, and D each contain nonsignificant forest plan amendments to address issues related to MSO and northern goshawk issues on the Coconino and Kaibab NFs. These amendments focus on allowing treatments in MSO PACs and northern goshawk habitats that are currently outside the authority of the current plans. These amendments are needed to accomplish the objectives of restoration as defined in the 4FRI. The expected results are increased resiliency and forest health in the treated areas as well as reduction in fire risk in these areas. With design features and actions mitigated, no amendment is expected to change the analysis for sensitive plants or for noxious or invasive weeds. Minor but insignificant changes to the amount of canopy cover and interspaces would result. These changes could result in minor but insignificant increases in growing space for all understory plants including sensitive plants and noxious or invasive weeds. The results would be minor increases in resources for sensitive plants and a slight increase in opportunities for new occupation but these effects are minor and

Species	Alternatives B, C, and D Environmental Consequences (Direct, Indirect, Cumulative)
	discountable. There may also be a minor but insignificant increase in disturbance resulting from treatments that would occur because of these treatments, but the increase would not significantly increase the risk of noxious or invasive weed invasions. Amendment 2 (alternative C only) to the Kaibab NF plan: The effects to sensitive plants and noxious or invasive weeds resulting from the change in management of this area would be the same as those to similar areas discussed in the report. The area was analyzed in the 1988 plan as a potential RNA but the process to designate and establish the RNA was never completed. As a result, restrictions to the area currently remain in place. The restrictions on management activities in the area that result from the RNA designation would no longer apply when the revised forest plan is completed and implemented. In the draft revised forest plan (2012), the area would be managed as the Garland Prairie Management Area. The treatments proposed in alternative C would benefit the understory vegetation community in the RNA by reintroducing natural processes and reducing competition from trees to grassland plants and would achieve the goal of restoring fire. Management actions in alternative C would move the area toward this condition, which would be complementary to the objectives of the Kaibab NF plan (1988) and 4FRI.

Northern Goshawk

This analysis addresses policy requirements and responds to key issues raised by the public including Issue 2, conservation of large trees, and Issue 3, canopy cover and post-treatment landscape openness in the context of impacts to goshawk and post-treatment viability. Metrics used to evaluate impacts are described in environmental consequences. The analysis utilizes and incorporates by reference the silviculture report (McCusker 2013).

Surveys

Most of the ponderosa pine, ponderosa pine/Gambel oak, and mixed-conifer habitats on the Coconino NF have been surveyed according to Southwestern Region protocol for the northern goshawk. Northern goshawk territories have been monitored every year since 1989, with an average of 43 territories monitored from 1991 to 2001. As of 2008, there were 70 known territories on the Coconino NF. The occupancy rate of territories has declined over the last 11 years. However, the goals of monitoring are to gain information on territory occupancy and reproduction; data collected on the forest are not designed to detect changes in population trends.

Data for the Kaibab NF show a similar decline in occupied territories using data from 1996 to 2007. There are currently 68 goshawk territories on the southern portion of the Kaibab NF, including 36 goshawk PFAs on the Kaibab NF portion of the project area. However, if future weather patterns produce good precipitation, the population could stabilize. Continued reduction of forest stem density and basal area should ameliorate the stochastic nature of weather by reducing the threat of large-scale, high-severity fire, thereby helping stabilize the population. See the wildlife report for monitoring details and the history of goshawk occupancy on the forests.

Summary of Habitat Condition

The existing and desired conditions for forest structure and vegetation features relevant to prey species in goshawk habitat are summarized in chapter 1.

Scales of Analysis

An analysis at three spatial scales is required by the Coconino and Kaibab NF forest plans for goshawk habitat. Evaluations of post-fledgling family area (PFA) habitat (used for nesting, breeding, and primary foraging during the nesting season) and landscapes outside of the PFA (referred to as LOPFA which is used primarily for foraging), was conducted at the project, subunit, and RU levels. An additional fourth scale of analysis was conducted at the landscape scale, and it included all of the ponderosa pine within the project area.

Nest areas are the smallest unit of northern goshawk habitat and potentially the most limiting. Just over one-quarter of nest areas fall within either protected or restricted MSO habitat. The PFA area immediately surrounding the nest area provides the closest foraging opportunities as well as alternate nesting sites. Similar to the nest area, about the same portion of the PFA, slightly less than one quarter, is considered MSO habitat.

Project Level Analysis

Within nest areas, PFA, and dispersal PFA (dPFA), all of the acres within the respective goshawk strata were included in the calculations for VSS and changes to VSS within these areas. For the LOPFA, only those acres that were managed to northern goshawk prescriptions were included, which would be about 78 percent of the acres.

The existing ratios of VSS within nest areas/PFA/dPFA at the project level are distributed with about four-fifths or 87 percent of the areas in the mid-seral VSS 3 and VSS 4. This is about double the acreage desired for mid-seral structure in goshawk habitat. Additionally, young seral forest is about a level of magnitude below desired conditions for the distribution of VSS classes across the landscape.

Restoration Unit (RU) Level of Analysis

The VSS distribution for the RU level is thoroughly analyzed in detail in the silvicultural report. The VSS distribution is dominated by VSS 3 through VSS 6 in uneven-aged PFAs and LOPFAs. Eighty to 100 percent of the habitat is VSS 3 and 4 in even-aged PFA and LOPFA. The only exception is RU 5 where 64 percent of the LOPFA is in VSS 3 and 4. Over a quarter of the LOPFA in RU 5 is VSS 1 and the remainder is in VSS 5 and 6.

Landscape Level of Analysis

For the landscape perspective, the ponderosa pine vegetation is addressed, encompassing the entire treatment area where changes would occur if the 4FRI is implemented. The existing condition is not that different from the other goshawk strata analyzed above.

Environmental Consequences

Alternative A

There would not be any direct effects from the alternative. Individual forest projects would continue to move some acreage toward desired conditions, but the overall landscape would change slowly. VSS distribution within PFAs would develop more slowly, relative to the action alternatives, and move toward more VSS 5 and 6 as trees develop and mature. As modeled in the silviculture analysis, this would minimally meet forest plan direction for late successional habitat with a combined total of 37 percent of the landscape by 2050. There would be no groups of VSS 1 or 2 by 2050, limiting regeneration to individual trees scattered under existing canopies.

With few openings and a relatively continuous canopy, "volunteer" regeneration would not be likely to support a continuous flow of trees into larger size classes. This would not promote a sustainable distribution of age classes, would not provide the variety of habitats used by key goshawk prey species, and so overall would not meet the desired conditions (see "Vegetation Analysis"). By 2050, overall VSS ratios would approach forest plan direction in even-aged LOPFA habitat, but uneven-aged stands would not regenerate stands of VSS 1 and 2, and VSS 3 and 4 would remain high occupying about 50 percent of the LOPFA.

Alternative A would not improve prey species habitats associated with springs, along ephemeral channels, or in aspen, meadows, grasslands, and savannas. Use of any open roads would continue the current level of disturbance occurring within PFAs and would not improve the quality of the adjacent habitat.

Alternatives B, C, and D

In total, the Coconino NF has 45,415 acres of occupied goshawk habitat. Alternative B would treat about 38 percent of the forestwide occupied habitat, alternative C would treat about 39 percent, and alternative D about 33 percent. On the Kaibab NF there are 124,938 acres of occupied goshawk habitat forestwide. The main difference in forestwide occupied habitat between forests is largely due to the Kaibab NF hosting over 20 years of goshawk research on the North Kaibab Ranger District. All alternatives would treat about 11 percent of the forestwide occupied goshawk habitat on the Kaibab NF.

Forest Structure

All action alternatives would move the VSS balance in PFA habitat toward desired conditions through treatments designed to enhance goshawk habitat. Alternatives B, C, and D would have similar results in moving the LOPFA toward balancing VSS ratios immediately post treatment (2020) by increasing the amounts of VSS 5 and 6 by primarily treating the abundant VSS 3 and 4 size classes. By 2050, all action alternatives would create more VSS 5 and 6 than is described in the forest plans, but compared to the no action alternative, the treatments would move goshawk habitat in a trajectory toward desired conditions. Prescribed burning in VSS 3 and 4 under alternatives B and C would move more acres into VSS 5 and 6 than would occur in alternative D. Post-treatment conditions would change the VSS distribution and promote an interspersion of regeneration groups and interspace, leading to future uneven-aged development within the existing forest. Under all scenarios, VSS 5 and 6 would exceed 50 percent of the landscape by the year 2050.

Analysis at the Subunit, Restoration Unit, and Landscape Scale

When analyzed at the subunit scale, the changes in scale did not change the patterns of habitat response to proposed treatments. The analysis of VSS changes among the subunits is discussed in the silviculture report. The existing conditions of VSS are listed in tables by subunit and RU in appendix 9 of the wildlife report.

At the RU scale, the trends in changes are similar as are the reasoning for the resultant cause and effect discussed above. The VSS distribution for the RU level is thoroughly analyzed in detail in the silvicultural report. See appendix 10 of the wildlife report for pie charts displaying the relative percent of VSS by RU by alternative over time. These provide a visual picture of the relative changes to goshawk nesting habitat among the RUs.

At the landscape scale, the existing condition is again similar to the other goshawk strata analyzed above. The changes to the VSS distribution for ponderosa pine vegetation in the treatment areas without consideration of special species status are similar to those seen at the various scales discussed above.

Alternatives B and C show essentially identical changes at this scale. The changes in percent VSS are attributed to removing the VSS 3 and 4 size trees through mechanical harvest and prescribed fire and leaving the large trees that comprise VSS 5 and 6. Alternative D shows slightly less increase in VSS 5 and 6, or acres of large trees, due to the lack of prescribed fire in the dense VSS 3 and 4 size classes occupying the majority of the area.

Prey Habitat

The vegetation analysis describes the changes in the physical features associated with prey species habitat in ponderosa pine including CWD, logs, and snags. All alternatives would meet forest plan direction for CWD by providing 5 to7 tons per acre by the year 2050 (table 41). Alternative D would provide the most CWD and alternatives B and C the least as a result of the differences in the use of prescribed fire. Logs would be below forest plan guidance, but the action alternatives would provide as many or more logs per acre than the no action alternative. While numbers varied by alternative, PFA habitat would generally support more logs per acre than LOPFA. Snags would increase over time but be below forest plan direction in all alternatives. However, alternative A would provide the least amount of snags, alternatives B and C the most, and results from alternative D would be in the middle regardless of which goshawk habitat is modeled (PFA or LOPFA). See the wildlife report for the detailed analysis of effects to prey species.

The main difference among the action alternatives is prescribed fire. Alternative D would have considerably less prescribed fire smoke when compared to alternatives B and C. First-entry burns would be expected to produce more smoke, and results from second-entry burns would be expected to better simulate the evolutionary environment of goshawks in the Southwest. The first-entry burns would be expected to produce elevated levels of smoke due to the uncharacteristic levels of litter and woody debris that have accumulated since the late 1800s. The direct effect of this could be smoke inhalation by incubating adults or nestlings, or extended absence of the adults during brooding or when the chicks are very young. This could potentially lead to loss of egg viability, loss of nestlings, or permanent damage to the developing lungs of goshawk chicks.

Alternatives B and C would move the most acres of PFA habitat toward desired conditions with the combination of mechanical and prescribed fire treatments. Alternative D would move slightly fewer acres toward desired conditions.

Other Activities in Alternatives B, C, and D

Roads

An impact associated with the mechanical treatments would be the use of temporary roads for vehicles and equipment. About 32 miles of temporary roads would be constructed within 25 known occupied PFAs and 8.7 miles would be within 8 dispersal PFAs: 19 PFAs (26 percent) would have less than 1 mile of temporary road construction; 11 PFAs (15 percent) would have 1 to 2 miles of temporary road construction; and 3 PFAs (4 percent) would have more than 2 miles of temporary road construction. Forty PFAs (55 percent) in the project area would not have temporary road construction. About 8 miles of temporary roads would be constructed within PFA nest areas. Two PFAs would have more than 1 mile of temporary road construction.

The effects of temporary road construction to goshawk PFA and nest habitat include removal of trees and understory vegetation along the road alignment. During the use of the temporary road, the habitat quality of the narrow linear configuration of the road would not be good for goshawks or prey species. Implementing breeding season timing restrictions would eliminate disturbance impacts to nesting goshawks. After the road is closed and obliterated, the disturbed area would provide habitat in the created opening for early seral stage prey species discussed earlier.

Relocating road segments would account for about 0.7 mile within nine PFAs. Four nest areas would be impacted by about 0.2 mile of reconstructed road. The impacts from reconstructed roads are similar to those associated with temporary roads. Reconstruction would move the disturbance associated with the road use from the original location to the new location. Given the probable close proximity of the old and new alignments, the degree of disturbance between the two locations would probably not be discernible. With each mile of road impacting approximately 3 acres, about 2 acres of habitat would be impacted by reconstructed roads. No acres would be impacted in alternative A.

About 517 miles of temporary roads would be constructed and decommissioned when treatments are complete (no new permanent roads would be constructed). Up to 40 miles of existing, open road would be reconstructed. About 30 miles of this reconstruction would be to improve roads for hauling harvested materials (primarily widening corners to improve turn radiuses) and about 10 miles would consist of relocating roads out of stream bottoms. Relocated roads would include rehabilitation of the moved road segment.

A total of 73 PFAs would have some sort of hauling occurring on roads in the PFA. Implementing a breeding season timing restriction for activities occurring within goshawk PFAs would eliminate most of the disturbance potential to goshawks from all of the proposed activities (see design features in appendix C for specific timing restriction language). The breeding season timing restriction is taken directly from the forest plan and would limit human activity within the PFA from March 1 through September 30 each year. If territories are monitored and found to be unoccupied, the breeding season timing restriction may be suspended for that particular season. Timing restrictions would prevent hauling during the breeding season in all but three PFAs.

The three PFAs without timing restrictions on hauling are in an area with some of the highest projected amounts of project activity and associated hauling traffic. Depending on active nest site selection and occupancy, timing, volume of materials hauled in a season, and other factors related to operations, logging truck traffic could potentially pass through up to two of the above three PFAs during the nesting season. Goshawk surveys would be done before hauling to evaluate occupancy and location of active nests in these three PFAs.

Noise disturbance from logging trucks was monitored for nesting goshawks in a study coordinated between the Kaibab NF, Rocky Mountain Research Station, U.S. Army, and a private sound consultant. Results from this field based, controlled experiment found no evidence of negative effects from truck noise. Observed goshawk response to logging truck noise was limited to, at most, looking in the direction of the hauling road (Grubb et al. 2012). However, this study measured the effects of a single truck on nesting goshawks. Thousands of truck trips may cause more pronounced behavior, depending largely on the distance to the nest and any intervening topography and vegetation. Disturbance from hauling will vary based on which nest site is selected during the time that hauling occurs. Therefore, road disturbance, even with thousands of truck trips, may cause little or no disturbance. Conversely, an active nest could occur in an area where past road noise has been minimal, but which could support high levels of road use that particular year. In summary, hauling may cause no noise disturbance to goshawks, but there would be potential to disrupt reproduction and rearing of young by, at most, one to two pairs of goshawks. Reducing potential disturbance to somewhere between zero to 2 PFAs out of 73 total PFAs meets forest plan direction "to minimize disturbance in the nest area."

In alternatives B, C, and D, decommissioning 904 roads would improve the quality of the habitat in those areas where the roads are decommissioned. While the physical structure and features of the habitat for goshawks and their prey may not measurably change along the former road alignment, eliminating disturbance along the roadway would be expected to improve the quality of habitat beyond the immediate area of the road for the goshawk and its prey species. With each mile of open road impacting approximately 3 acres of habitat, about 2,712 acres of forested habitat may be impacted. This would not have a discernible impact to goshawk habitat across the landscape. Implementing these activities under the breeding season timing restrictions would eliminate disturbance to nesting goshawks.

Dust abatement treatments would occur in selected areas where private land ownership concerns could arise. Eight road segments have been identified for dust abatement, totaling less than 7 miles in length. The average dust abatement treatment length would be about 0.9 mile, ranging from 0.3 to 2.5 miles. Treatments would consist of $MgCl_2$ or lignin. The effectiveness of $MgCl_2$ is related to humidity levels (Batista et al. 2002); therefore, lignin would probably be used most often in the 4FRI landscape. Treatments would be temporary, only occurring on particular road segments in association with hauling. None of the proposed treatment segments would be near open water. Because of the limited application spatially and temporally, and because locations do not include sensitive areas such as open water, dust abatement is not expected to result in measurable effects to wildlife or their habitat.

Springs, Ephemeral Channels, and Aspen

Improving springs and restoring ephemeral channels in alternatives B, C, and D would improve prey species habitat in those areas where the treatments occur. Implementing breeding season timing restrictions would alleviate disturbance to goshawks during the nesting season during activities. Adaptive management actions in alternative C does not change the percent of habitat treated.

Mechanical treatments in aspen in the action alternatives would improve the quality of the aspen habitat for goshawk prey species including the red-naped sapsucker. There would be greater improvement in alternatives B and C, which implement prescribed fire with the mechanical treatments, than in alternative D which only uses mechanical treatments in aspen. Alternative A would not improve any acres of aspen habitat and would, therefore, maintain the current decline in aspen habitat. Implementing the breeding season timing restrictions for any activities within PFAs would eliminate disturbance to nesting goshawks.

Other Activities

The effects of MSO prescriptions on goshawk habitat in the action alternatives are reflected in the vegetation data already analyzed. MSO prescriptions would impact approximately 22 percent of the goshawk habitat across the landscape. MSO habitat likely supports lower densities of rodent prey species than would habitat treated to meet goshawk habitat direction in the forest plan (see appendix 8 in the wildlife report). However, MSO treatments in protected and target and threshold habitats would be similar to the desired conditions for goshawk nesting habitat. Treatments in MSO restricted other habitat should improve prey habitat. Because goshawks are generalist species, MSO based management treatments would not be in conflict with maintaining goshawk territories in MSO habitat.

For the research proposals in alternative C, impacts of the silvicultural prescriptions have been reflected in the vegetation data already analyzed. Constructing 15 weirs that would impact 3 acres would not have a discernible impact to goshawk habitat at the project level. Impacts to goshawks or their prey species habitat would be limited to the immediate vicinity of the locations of the individual projects. Alternatives B and D would not have any impacts to changing the physical structure or quality of the goshawk habitat from this facet of the project as it is not included in these alternatives.

Cumulative Effects

Most past vegetation treatment projects after 1996 have been designed to move the landscape toward the desired conditions for northern goshawks. Those same projects have also included breeding season timing restrictions for activities within goshawk PFAs. This project would contribute to the cumulative effects of moving the landscape toward desired conditions for the northern goshawk.

Alternatives B and C contribute most to moving the landscape toward desired conditions. Alternative D does slightly less to move toward desired conditions. While some desired physical features may be achieved in alternative A, it does not contribute to the cumulative effects of moving the landscape toward desired conditions. See appendix 12 of the wildlife specialist report for the projects and their size, location, objectives, and wildfires addressed as part of cumulative effects

Other Protected Species

Golden Eagle

Golden eagles are protected under the Bald and Golden Eagle Protection Act (Eagle Act). Because of their resemblance to bald eagles, project design features and mitigation have been developed (see “Environmental Consequences”).

Sightings of golden eagles have been documented, and winter surveys are conducted annually on the Flagstaff district (Coconino NF) and Williams district (Kaibab NF) within the project area. Bald eagle annual winter surveys also document golden eagle sightings. There are 18 confirmed golden eagle nests representing 17 nesting areas in the project area (see wildlife report). There are 11 additional potential nests but they have not yet been confirmed. Potential and confirmed nesting golden eagles within the project are located in subunits 1-1, 1-3, 1-6, 2-0, 3-1, 3-4, 3-5, 4-1, 4-2, 4-3, 4-4, 5-2 and 6-2. Golden eagles often nest in areas of high rabbit populations. Golden eagles are well known for subduing large prey; however, most of their diet consists of ground squirrels, rabbits, and prairie dogs. Potential foraging habitat within the treatment area is primarily 48,774 acres of grassland.

Environmental Consequences – All Alternatives

In alternative A, there are no direct effects to golden eagles. There would be no meadows treated within the project area and trees would continue to encroach, reducing potential habitat for small mammals and consequently golden eagles. Dense forest conditions would still occur, slowing growth rates and limiting development of larger diameter (≥18 inch) trees important for nesting and roosting as well as maintaining high fire hazard potential that would continue to place potential breeding, nesting, and foraging habitat at risk with respect to stand-replacing fire.

The effects for alternatives B, C, and D reflect design features and mitigation as described for the bald eagle (see appendix C in the DEIS). In alternatives B, C, and D, mechanical treatments, prescribed fire, road construction and decommissioning, and the hauling of timber and other restoration activities may cause visual or auditory disturbance that would be localized, of short duration, and low intensity. Effects of mechanical treatments would not be expected to substantially interfere with normal feeding behavior. Acres of prescribed burning and mechanical treatment would result in short-term effects and would be minimized due to activities being spatially and temporally separated.

The effects of alternative C are similar to those of alternatives B and D. Alternative C restores more acres of potential foraging habitat, and the added mechanical treatments within grasslands would maintain and improve more foraging habitat. There are no nests or roosts within the additional grassland treatments or research areas; therefore, no additional effects would occur from disturbance. Alternative D has the same effects as alternative B with one exception. The lack of prescribed fire after thinning treatments would affect surface vegetation patterns as shrubs and other species adapted to fire continue to decline (Huffman and Moore 2004, Moir 1988). The loss of habitat effectiveness would indirectly lead to adverse effects for golden eagles by limiting prey habitat.

Cumulative Effects – All Alternatives

The area analyzed for cumulative effects for the golden eagle is the project area and a ½-mile buffer around the project boundary. Past, present, and reasonably foreseeable projects are listed in appendix 12 of the wildlife report and past projects have implemented thinning on 2,304 acres and prescribed fire on 8,951 acres in grasslands.

In alternative A, continued pine tree encroachment into grasslands and private development in grasslands would result in a cumulative impact along with such activities as grazing and high impact recreational use to limit meadow and grassland habitats. Prescribed fire on 98,800 acres in adjacent projects may result in short-term impacts to habitat, but these are not expected to result in long-term cumulative impacts and are expected to be localized in nature. This alternative would result in the most stress on meadow and grassland habitats and, thus, would have the greatest negative contribution to potential golden eagle habitat.

In alternatives B, C, and D, there would be no effect to nesting eagles; however, there may be potential short-term disturbance to potential foraging habitat with long-term benefits. Short-term disturbance to foraging eagles would occur during thinning, hauling, temporary road construction, and prescribed fire activities and may cause eagles to forage in nearby areas for the duration of the activity. Other activities occurring that may have similar effects include temporary disturbances caused by prescribed fire (104,750 acres) and thinning (104,990 acres) in adjacent projects, or effects to roosting habitat from utility infrastructure development and maintenance (500 acres). These short-term impacts added to similar effects from other activities were considered. Implementation activities of other fuel reduction project activities could occur simultaneously; however, it is not anticipated it would combine to cause a negative effect.

Determination of Effects for All Alternatives

The proposed treatments and activities **would not result in take as defined in the Eagle Act for golden eagles.** All nests would be protected from disturbance during project implementation. Project design features would mitigate potential for disturbance from noise or smoke to nesting golden eagles. Project activities would not substantially interfere with foraging behavior. Restoration treatments would improve foraging habitat and reduced potential of high-severity fire impacting nest locations.

Forest Plan Amendments – Sensitive and Other Protected Species

Not incorporating these amendments would affect the habitat of most sensitive species addressed in this report (see the wildlife report for the complete analysis). The MSO amendments would allow managing for lower tree densities and basal area, creating canopy gaps, creating and sustaining more large pine and oak trees in the long-term, more large snags through time, and increasing understory response. Not incorporating these amendments would allow:

- uncharacteristically dense forest conditions, fewer big pine and oak trees, and increased fire risk for wildlife using forested habitats in 18 PACs (related to the proposed mechanical treatments in all action alternatives);
- uncharacteristically dense forest conditions, lower crown base height, and increased fire risk in 56 PACs (related to the proposed prescribed fire treatments in alternative C only);
- fewer PACs attaining the desired post-treatment condition due to sequencing of treatments through time (all action alternatives);
- uncharacteristically dense forest conditions, fewer canopy openings, and fewer large pine and oak trees in restricted habitat that would be managed as threshold habitat where no resident MSOs exist on the Kaibab NF (all action alternatives);
- tree densities maintained well above the minimum basal area stand values recommended in the MSO recovery plan across all PACs, target, and threshold habitats (i.e., not using the best science available; alternative C only); and
- understory conditions would continue to decline across MSO habitat, affecting prey habitat and likely decreasing the total prey biomass for raptors and carnivores.

Not including the amendment related to management of canopy cover and open reference conditions within ponderosa pine forest would prevent the ability to include rooting space necessary to sustain dense groups of trees, reduce forest densities and associated forest health (measured by the percent maximum SDI), and prevent the restoration of grasslands and savanna. This would decrease the ability to maintain dense groups of trees along with shrub and herbaceous vegetation, decreasing foods for herbivores, granivores, insectivores, and so for carnivores as well. Grassland species and dispersing individuals of prey species (primarily rodents and lagomorphs) that aid in maintaining prey populations in forested habitat would be reduced as trees continue to encroach upon open habitats. Simultaneously, habitat for species that depend on closed canopy would gradually increase.

Not managing the proposed Garland Prairie Research Natural Area for the grassland characteristics it was intended to support would result in similar dynamics, i.e., the development of forest structural characteristics used by some species while reducing habitat effectiveness for open habitat species.

Currently, many of the sensitive species depend on habitats or habitat elements related to canopy openings. Existing closed-canopy forests limit or eliminate many of the necessary habitat components needed by these species. The desired condition of closed canopy tree groups interspersed with open rooting space that supports herbaceous vegetation would provide key habitat components for these species of status as well as species adapted to closed-canopy forests. Achieving this situation is the reason for the amendments and this interspersion of habitats, which is a fundamental part of the desired condition, would not be attained without incorporating the amendments into the action alternatives.

Forest Service Management Indicator Species (MIS)

Table 72 summarizes (with rationale) the MIS species not analyzed. Table 73 summarizes the MIS species analyzed. The table provides the current forestwide habitat and population trends. The effects analysis is organized by habitat type with habitat trends presented in narrative and population trends summarized in tables with some exceptions. Both habitat and population trends are displayed in tabular form for snags in ponderosa pine (hairy woodpecker), late-seral aspen and snags in aspens (red-naped sapsucker), and early-seral aspen and pinyon-juniper (mule deer). Aquatic MIS are analyzed separately in the "Aquatics Species" section of this chapter.

Table 72. MIS not analyzed in the analysis

Management Indicator Species	Key MIS Habitat Component Indicator	Comments
Aquatic Macroinvertebrates **Kaibab NF only**	Riparian	Only an indicator of stream quality in North Canyon Creek on the North Kaibab Ranger District, Kaibab NF. Outside of project area.
Mexican Spotted Owl (*Strix occidentalis lucida)*	Late-seral mixed conifer and spruce-fir	There is no mixed conifer or spruce-fir habitat being treated in the proposed treatment area.
Red Squirrel (*Tamiasciurus hudsonicus*)	Late-seral mixed conifer and spruce-fir	There is no mixed conifer or spruce-fir habitat being treated in the proposed treatment area.
Yellow-breasted Chat (*Icteria virens*)	Late-seral, low-elevation, riparian habitat (< 7,000′)	There are 6 miles of proposed ephemeral stream channel restoration with riparian vegetation on the Coconino NF; only a fraction of this habitat occurs below 7,000 feet elevation. Riparian vegetation within these ephemeral channels does not include woody vegetation. No stream restoration with riparian habitat would occur on the Kaibab NF. The proposed restoration would not remove woody riparian vegetation. Thinning and prescribed fire could increase water yield for up

Management Indicator Species	Key MIS Habitat Component Indicator	Comments
		to 5 years. This would not affect the late-serial riparian habitat.
Lucy's Warbler (*Vermivora luciae*)	Late-seral, low-elevation, riparian habitat (< 7,000′)	There are 6 miles of proposed ephemeral stream channel restoration with riparian vegetation on the Coconino NF; only a fraction of this habitat occurs below 7,000 feet elevation. Riparian vegetation within these ephemeral channels does not include woody vegetation. No stream restoration with riparian habitat would occur on the Kaibab NF. The proposed restoration would not remove woody riparian vegetation. Thinning and prescribed fire could increase water yield for up to 5 years (see watershed report). This would not affect the late-seral riparian habitat.
Lincoln's Sparrow (*Melospia lincolnii*)	Late-seral, high-elevation riparian habitat (> 7,000′)	There are 6 miles of proposed ephemeral stream channel restoration with riparian vegetation on the Coconino NF. Riparian vegetation within these ephemeral channels does not include woody vegetation. No stream restoration with riparian habitat would occur on the Kaibab NF. The proposed restoration would not remove woody riparian vegetation. Thinning and prescribed fire could increase water yield for up to 5 years (see water quality report). This would not affect the late-seral riparian habitat.
Cinnamon Teal (*Anas cyanoptera*)	Wetlands	There are no proposed activities within wetland habitat. The 6 miles of proposed ephemeral stream restoration with riparian habitat is not teal habitat. Thinning and prescribed fire could increase water yield for up to 5 years. This would not affect the wetland habitat.

Table 73 displays MIS analyzed in this analysis, key habitat component indicator for each species, and the habitat within the treatment area. It summarizes current forestwide habitat and population trends, acres of forestwide habitat, and acres and percent of habitat analyzed in the project area. Data and best available science utilized for this analysis is described below.

The presence of species carried forward for analysis was determined by surveys conducted on the forest, surveys conducted by the Arizona Department of Game and Fish, and the FAAWN database (Patton 2011). Ten MIS whose distribution on the forest encompasses part or all of the treatment area were included in the effects analysis. The analysis is based also on the forest plan and projected changes in acreage of quality habitat under all of the alternatives.

Data and Best Available Science

MIS and the habitats they represent are listed in the most recent Kaibab NF (USDA 2010a) and Coconino NF (USDA 2002) forestwide management indicator species reports. As the MIS analysis was conducted throughout 2012, information from the draft report (Overby, pers. comm. 2012) was used in association with discussions with the Coconino NF biologist. A thorough review of the best available science, including the biology, ecology, and effects of management on individual species was included in the 2010 update of the Kaibab NF forestwide MIS report.

Information on species, their population trends, and habitat trends presented in the MIS forestwide reports are incorporated by reference.

Determining MIS presence and associated trend calls included data from the annual songbird surveys conducted on both the Coconino and Kaibab NFs. Surveys were initiated on the Kaibab NF in 2005 and on the Coconino NF in 2006. Initially each forest conducted its own survey effort, starting the season with 2 weeks of field training. The Rocky Mountain Bird Observatory took over the sampling effort and associated data analysis in 2007. One component of the bird survey effort is a sympatric tree squirrel survey. Initial results from this effort were included in the Abert’s squirrel effects analysis.

Population status and trend updates for all game species were provided by the AGFD for the 4FRI (see appendix 6 in the wildlife report) and incorporated into the analysis. Goshawk surveys are completed annually on both the Coconino NF and Kaibab NF. The goshawk field survey effort was coordinated between the two national forests in 2011 because of the scale of the restoration project and 6,485 acres were surveyed. The coordinated effort will continue in 2013.

The forest vegetation simulator (FVS) tree growth model was used to determine changes in forest stand dynamics (for more information on FVS, see the silviculture report). This information was used for changes in seral stages for ponderosa pine stands. Where possible, data on forestwide vegetation was taken from the forestwide reports for MIS species. If acreages were not available, potential natural vegetative type (PNVT) acreage was used. PNVT acreage for different vegetation types was developed for each forest as part of the forest plan revision process. The vegetation model (VDDT) from forest plan revision was used to determine available acres of early and late seral ponderosa pine habitat at the forestwide scale for the Coconino NF.

Table 73 and table 74 summarize MIS habitat and population trends by alternative.

Table 73. MIS analyzed and forestwide current habitat and population trends

Management Indicator Species	Key MIS Habitat Component Indicator	Habitat Component Analyzed	Current Forestwide Habitat Trend		Current Forestwide Population Trend		Acres of Key MIS Habitat Forestwide		Acres/Percent of Habitat Analyzed within Project Area	
			CNF	KNF	CNF	KNF	CNF	KNF	CNF	KNF
Aquatic Macroinvertebrates	Riparian	See aquatics MIS section								
Northern Goshawk	Late-seral ponderosa pine	Ponderosa pine	Decreasing	Increasing	Inconclusive	Decreasing	80,773	200,000	56,615/70%	27,921/14%
Pygmy Nuthatch	Late-seral ponderosa pine	Ponderosa pine	Decreasing	Increasing	Stable	Stable to declining	80,773	200,000	56,615/70%	27,921/14%
Turkey	Late-seral ponderosa pine	Ponderosa pine	Decreasing	Increasing	Increasing	Increasing	80,773	200,000	56,615/70%	27,921/14%
Abert's Squirrel (Coconino NF) /Tassel-eared Squirrel (Kaibab NF)	Early seral ponderosa pine	Ponderosa pine	Stable	Stable	Inconclusive	Stable	152,836	40,000	14,525/10%	7,411/ 18%
Rocky Mountain Elk	Early seral ponderosa pine, mixed conifer, and spruce-fir	Ponderosa pine	Stable	Stable	Stable to decreasing (latest AGFD data)	Stable to decreasing (latest AGFD data)	152,836	40,000	14,525/10%	7,411/ 18%
Hairy Woodpecker	Snags in ponderosa pine, mixed conifer and spruce-fir	Snags in ponderosa pine	Declining	Increasing	Stable or slightly increasing	Stable	900,426	681,158	322,772/ 36%	189,407/ 28%
Red-naped Sapsucker	Late-seral aspen and snags in aspens	Aspen and aspen snags	Stable(s)/ Decreasing (l)	Stable	Stable to Increasing (s)/Stable to Decreasing (l)	Stable (s)/ Decreasing (l)	10,000	28,500	875 to 1,083/ 9% to 11%	387 to 389 acres/1%

Management Indicator Species	Key MIS Habitat Component Indicator	Habitat Component Analyzed	Current Forestwide Habitat Trend		Current Forestwide Population Trend		Acres of Key MIS Habitat Forestwide		Acres/Percent of Habitat Analyzed within Project Area	
			CNF	KNF	CNF	KNF	CNF	KNF	CNF	KNF
Mule Deer	Early seral aspen and pinyon-juniper	Aspen	Declining	Declining	Declining	Stable to Increasing	10,000	28,500	875 to 1,083/ 9% to 11%	389/1%
		Pinyon juniper	Stable	Stable			630,000	657,900	10,786/1%	12,560/1%
Juniper Titmouse	Late-seral pinyon-juniper, and snags in pinyon-juniper	Pinyon-juniper and snags in pinyon-juniper	Stable	Increasing	Stable to slightly decreasing	Decreasing	630,000	657,900	10,786/1%	12,560/1%
Pronghorn	Early and late seral grasslands	Grassland	Stable to Declining	Stable	Declining to Stable (AGFD data)	Declining to Stable (AGFD data)	260,050	216.000	22,672/9%	25,871 to 26,152/12%

Table 74. MIS habitat and population trends by habitat and alternative

Species	Alternative A	Alternatives B, C, and D
Late Seral Ponderosa Pine—Coconino NF		
Northern Goshawk	In the long term (30 years), alternative A would result in an 11.5% increase in quantity of habitat with increased VSS 5 and 6 but the quality of the habitat would decrease as canopies closed and tree densities increased. A net increase in quantity of habitat with a decrease in quality of habitat coupled with some decreases in amounts of prey species' habitat and unknown to decreasing population trends for MIS prey species would be expected to have static impact on the population trend for goshawk.	Alternatives B and C would produce the largest increase in the quantity of late seral ponderosa pine habitat as well as the most improvement in the quality of habitat for goshawks and their prey species as all elements move toward desired conditions. Alternative D increases habitat quantity and improves habitat quality for goshawk and its prey species less than alternatives B and C. A net increase in quantity of habitat coupled with an increase in quality of habitat combined with increased habitat components for prey species and positive changes to prey species' habitat and increasing population trends would change population trend for the goshawk in the long term to increasing. Alternatives B, C, and D would likely continue the stable forestwide population trend in the short term while moving toward an increasing trend.
Pygmy Nuthatch	Alternative A would not result in an immediate change to the quantity or quality of habitat and would likely continue the current population trend of stable in the short term. With the likelihood of wildfires, the long-term population trend could change to decreasing.	Alternatives B, C, and D would protect nesting habitat and increase the quantity and quality of late-seral habitat over a large area of ponderosa pine habitat on the forest. Alternatives B, C, and D would likely continue the stable forestwide population trend in the short term while moving toward an increasing trend. Alternatives B, C, and D would likely change the forestwide population trend to increasing in the long term due to increasing in late-seral habitat over a large area of ponderosa pine habitat on the forest. Alternatives B and C would have similar impacts on the species, and alternative D would not be as beneficial.
Turkey	Alternative A would not result in an immediate change to the quantity or quality of habitat. Alternative A would likely continue the current forestwide population trend as increasing in the short term. With the likelihood of wildfire, loss of Gambel oak to shading from pines, and lack of understory development, the long term forestwide population trend could change to decreasing.	Alternatives B, C, and D would increase quantity and quality of the habitat. Population trend is influenced by other habitat factors than development of late-seral ponderosa pine, with the main factor being the State hunt structure. Alternatives B, C, and D would likely continue the forestwide population trend as increasing in both the short and long term; alternative D would not be as beneficial as alternatives B and C.
Late Seral Ponderosa Pine—Kaibab NF		
Northern Goshawk	Habitat quantity would increase by 11.5% in VSS 5 and VSS 6 but the quality of the habitat would deteriorate as canopies closed and tree densities increased and potential	Alternatives B and C would produce the largest increase in the quantity of late-seral ponderosa pine habitat as well as the most improvement in the quality of habitat for goshawks and their prey species as all elements move toward desired conditions. Alternative

Species	Alternative A	Alternatives B, C, and D
	understory production decreased. A net increase in quantity of habitat with a decrease in quality of habitat coupled with some decreases in amounts of prey species' habitat and unknown to decreasing population trends for MIS prey species would result in a static impact on the population trend for the goshawk.	D increases habitat quantity and improves habitat quality for goshawk and its prey species less than alternatives B and C. A net increase in quantity of habitat coupled with an increase in quality of habitat combined with increased habitat components for prey species and positive changes to MIS prey species' habitat and increasing population trends would be expected to have positive impact on the population trend for goshawk in alternatives B, C, and D.
Pygmy Nuthatch	Alternative A would not result in an immediate change to the quantity or quality of habitat and would likely continue the current population trend of stable to declining in the short term. With the likelihood of large-scale, stand-replacing wildfires the forestwide population trend could change to decreasing in the long term. With the likelihood of large-scale stand-replacing wildfires in the future, it is possible that the long term forestwide population trend could change to decreasing.	Alternatives B, C, and D increase the quantity and quality of late-seral habitat over a large area of ponderosa pine habitat on the forest. Alternatives B, C, and D would likely continue the stable forestwide population trend in the short term while moving toward an increasing trend. Alternatives B and C would have similar impacts on the species, and alternative D would not be as beneficial. Alternatives B, C, and D would likely change the forestwide population trend to increasing in the long term due to increases in late-seral habitat over a large area of ponderosa pine habitat on the forest. Alternatives B, C, and D continue the stable forestwide population trend in the short term while moving toward an increasing trend in the long term due to an increase in late-seral habitat over a large area of ponderosa pine habitat on the forest.
Turkey	Alternative A would likely continue the current forestwide population trend for the turkey as increasing in the short term. With the likelihood of wildfires, loss of Gambel oak to shading from pines, and lack of understory development, it is possible that the population trend could change to decreasing.	Alternatives B, C, and D would likely continue the forestwide population trend as increasing in both the short and long term. The population trend is influenced by other habitat factors than the development of late-seral ponderosa pine, with the main factor being the State hunt structure. Alternative D would not be as beneficial as alternatives B and C.
Management Indicator Species	**Alternative A**	**Alternatives B, C, and D**
Early Seral Ponderosa Pine – Coconino NF		
Elk	Alternative A would not result in an immediate change to the quantity or quality of habitat used by elk. Forage would decrease in the long term due to closure of the forest. Alternative A would likely continue the decrease in forestwide elk population trend due to removal of habitat components for elk in both short and long term and the	Alternatives B, C, and D would improve other forest habitat beside the increase of early-seral habitat for elk and would change the current decreasing population trend to increasing. However, population trends are influenced more by hunting than by forest management and they would remain as a decreasing trend until desirable population levels are determined.

Species	Alternative A	Alternatives B, C, and D
	current trend of the AGFD efforts to decrease the local herd size on the forest.	
Abert's Squirrel	Alternative A would continue to provide habitat for the short term. Long term, the unnatural stand densities would reduce habitat quality and quantity. Alternative A would not change the current stable, forestwide Abert's squirrel population trend in the short term but in the long term, would change the trend to decreasing due to the threat of high-severity fire in overly dense, continuous stands of forest.	In the short term, the habitat quality could be reduced, however, in the long term tree growth and increased canopy connectedness would improve habitat. Alternatives B, C, and D could have short-term impacts that could change the forestwide population trend to decreasing in the short term since the project area includes approximately 41 percent of the ponderosa pine habitat on the forest. For the long term, alternatives B, C, and D would likely change the forestwide population trend to an increasing trend. These habitat trends are based on other habitat components than early-seral ponderosa pine habitat.
Early Seral Ponderosa Pine – Kaibab NF		
Elk	Alternative A would not result in an immediate change to the quantity or quality of habitat used by elk. Forage would decrease in the long term due to closure of the forest. Alternative A would likely continue the decrease in forestwide elk population trend due to removal of habitat components for elk in both short and long term and the current trend of the AGFD efforts to decrease the local herd size on the forest. Alternative A would likely continue the decrease in forestwide elk population trend due to the removal of habitat components for elk in both short and long term, and the current trend of the AGFD efforts to decrease the local herd size on the forest.	Alternatives B, C, and D would improve other forest habitat beside the increase of early-seral habitat for elk and would change the current decreasing population trend to increasing. However, population trends are influenced more by hunting than by forest management, and they would remain as a decreasing trend until desirable population levels are determined.
Tassel-eared Squirrel	Alternative A would continue to provide habitat for the short term. Long term the unnatural stand densities would reduce habitat quality and quantity. Alternative A would not change the current stable forestwide Abert's squirrel population trend in the short term, but in the long term could shift the trend to decreasing due to the overly dense stands and chance for large-scale removal of habitat from fires in the long term.	In the short term, the habitat quality could be reduced, however, in the long-term tree growth and increased canopy connectedness would improve habitat. Alternatives B, C, and D could have short-term negative impacts, but it is not known if that would change the forestwide population trend to decreasing in the short term since the project only includes approximately 37 percent of the ponderosa pine habitat on the forest. However, for the long term, alternatives B, C, and D would likely change the forestwide stable population trend to an increasing trend. These habitat trends are based on other habitat components than early-seral ponderosa pine habitat.
Snags in Ponderosa Pine – Coconino NF		
Hairy	Alternative A would increase the	The three action alternatives are designed to restore

Species	Alternative A	Alternatives B, C, and D
Woodpecker	amount of late-seral stands in the long term. The risk of a large-scale wildfire is high. Alternative A would not change the short-term forestwide habitat or population trend for the hairy woodpecker since it continues the current level of activities on the forest. In the long term, it is likely the forestwide habitat and population trends would be stable to decreasing for the species due to the threat of large stand-replacing wildfires.	ponderosa pine stands closer to historical range of variation. This results in forest structure that includes large trees and an abundance of snags. Alternatives B, C, and D would likely continue the stable forestwide habitat and population trend in the short term, with decreased snag habitat in the short term. In the long term, alternatives B, C, and D would change the forestwide habitat and population trend to increasing.
Snags in Ponderosa Pine – Kaibab NF		
Hairy Woodpecker	Alternative A would increase the amount of late-seral stands in the long term. The risk of a large-scale wildfire is high. Alternative A would not change the short-term forestwide habitat or population trend for the hairy woodpecker since it continues the current level of activities on the forest. In the long term, it is likely the forestwide habitat and population trends would be stable to decreasing for the species due to the threat of large stand-replacing wildfires.	The three action alternatives are designed to restore ponderosa pine stands closer to historical range of variation. This results in forest structure that includes large trees and an abundance of snags. Alternatives B, C, and D would likely continue the stable forestwide habitat and population trend in the short term, with decreased snag habitat in the short term. In the long term, alternatives B, C, and D would change the forestwide habitat and population trend to increasing.
Late-seral Aspen and Snags in Aspens – Coconino NF		
Red-naped Sapsucker	Alternative A would continue the declining habitat trend. Alternative A would likely not change the decreasing red-naped sapsucker forestwide population trend in the short term, and it would likely remain decreasing in the long term. Approximately 11 percent of the aspen on the district would not be treated and would likely continue to decline or be lost to wildfires.	Alternatives B, C, and D would change the forestwide habitat trend to stable in the short term and increasing in the long term. In the long term, the forestwide population trend would likely either be stable or increasing as a result of treating about 9 to 11 percent of the aspen habitat on the forest. Nevertheless, it will take time to recruit large trees and snags into the system.
Late-seral Aspen and Snags in Aspens – Kaibab NF		
Red-naped Sapsucker	The forestwide MIS assessment (USDA 2010a) shows a likely decreasing habitat and population trend in the future without aspen restoration. In the short term, alternative A would not change the current stable forestwide trends for red-naped sapsuckers or their habitat. However, it would change both the forestwide habitat and population trends to decreasing in the long term.	Alternatives B, C, and D would continue the forestwide population and habitat trend as stable. While they would improve habitat in the areas proposed for treatment, this would only represent 1 percent of the aspen on the forest and would not change the population or habitat trend for the red-naped sapsucker in the short or long term.

Species	Alternative A	Alternatives B, C, and D
Early-seral Aspen and Pinyon-Juniper – Coconino NF		
Mule Deer	Alterative A would not change the forestwide habitat trend in aspen or pinyon-juniper habitat in the short or long term. Early-seral aspen would continue to decline due to the lack of recruitment. The pinyon-juniper habitat would remain stable because the project would only affect 2 percent of the habitat on the forest. Alternative A would not change the mule deer population trend in the short term because the population trend is due mainly to hunting and not management actions. There is potential for a decreasing trend in the long term due to the potential of large-scale, stand-replacing wildfires.	Alternatives B, C, and D would promote the development and recruitment of aspen early-seral habitat. This could change the forestwide habitat trend toward stable in the short and long term because the alternatives would improve 9 to 11 percent of the aspen forestwide. The alternatives would not change the current stable forestwide habitat trend for pinyon-juniper habitat due to the fact that less than 1 percent of the pinyon-juniper habitat forestwide would be affected. The action alternatives would likely keep the mule deer forestwide population trend at stable both in the short and long term due to improvement in other habitat components that would benefit the deer, however, forestwide population trends are more affected by hunting than forest management.
Early-seral Aspen and Pinyon-Juniper – Kaibab NF		
Mule Deer	Alterative A would not change forestwide habitat trend in either aspen or pinyon-juniper habitat in the short or long term. Early-seral aspen would continue to decline due to the lack of recruitment. The pinyon-juniper habitat would continue to be stable due to the fact that the project would only affect 1 percent of the habitat on the forest. Alternative A would not change the mule deer forestwide population trend in the short term, since the population trend is due mainly to hunting and not management actions. There is potential for a decreasing population trend forestwide in the long term due to the potential of large-scale stand-replacing wildfires.	Alternatives B, C, and D would promote the development and recruitment of aspen early-seral habitat, but would not change the short and long term early-seral forestwide habitat because it would only affect about 1 percent of the aspen forestwide. Alternatives B, C, and D would not change the current stable forestwide habitat trend for pinyon-juniper habitat due to the fact that less than 1 percent of the pinyon-juniper habitat forestwide would be affected. Alternatives B, C, and D would likely move the mule deer forestwide population trend to stable both in the short and long term due to improvement in other habitat components that would benefit the deer, however, forestwide population trends are more affected by hunting than forest management.
Late Seral Pinyon-Juniper and Snags in Pinyon-Juniper Habitat – Coconino NF		
Juniper Titmouse	Alterative A would not change forestwide habitat or population trend in the short or long term. The trends would continue to be stable due to the fact that the project would only affect 1 percent of the habitat on the forest.	Alternatives B, C, and D would help reduce tree density and develop understory components in pinyon-juniper stands, but would not change the short or long term forestwide habitat or population trends from stable because less than 1 percent of the pinyon-juniper habitat forestwide would be affected.
Late Seral Pinyon-Juniper and Snags in Pinyon-Juniper Habitat – Kaibab NF		

Species	Alternative A	Alternatives B, C, and D
Juniper Titmouse	Alterative A would not change forestwide habitat trend in pinyon-juniper habitat in the short or long term. Pinyon-juniper habitat would continue to be stable due to the fact that the project would only affect 1 percent of the habitat on the forest. Alternative A would not change the juniper titmouse forestwide population trend in the short or long term.	Alternatives B, C, and D would help reduce the tree density and develop understory components in the pinyon-juniper stands but it would not change the short or long term forestwide habitat or population trends from stable because less than 1 percent of the pinyon-juniper habitat forestwide would be affected.
Early and Late Seral Grasslands – Coconino NF		
Pronghorn	Alternative A would not change the current stable trend for pronghorn populations and forestwide habitat in the short term, but in the long term, it would change both forestwide habitat and population trends to decreasing due to the continued decline in grassland conditions from conifer and shrub encroachment.	Alternatives B and D would keep the forestwide grassland habitat trend at stable to increasing depending on how much conifer and shrub are removed. The alternatives would likely have the forestwide pronghorn population trend as stable to increasing but the forest population trends are largely influenced by hunting and drought. Alternative C would change the forestwide grassland habitat trend to increasing in both short and long term due to the removal of trees in current grasslands and the restoration of historical grasslands. It would keep the forestwide pronghorn population trend as stable to increasing.
Early and Late Seral Grasslands – Kaibab NF		
Pronghorn	Alternative A would not change the current stable trend for pronghorn populations and forestwide habitat in the short term, but in the long term it would change both forestwide habitat and population trends to decreasing due to the continued decline in grassland conditions from conifer and shrub encroachment.	The alternatives would likely keep the forestwide pronghorn population trend as stable to increasing but the population trends for pronghorn are largely influenced by hunting and drought. Alternative C would change the forestwide grassland habitat trend to increasing in both the short and long term.

Forest Plan Amendments

Not incorporating the amendments would affect the habitat of most of the MIS addressed in this report (see the wildlife specialist report for the complete analysis). The MSO amendments would allow managing for lower tree densities and basal area, creating canopy gaps, creating and sustaining more large pine and oak trees in the long term, more large snags through time, and increasing understory response. Not incorporating these amendments would allow:

- uncharacteristically dense forest conditions, fewer big pine and oak trees, increased fire risk for wildlife using forested habitats in 18 PACs (related to the proposed mechanical treatments in all action alternatives);

- uncharacteristically dense forest conditions, lower crown base height, and increased fire risk in 56 PACs (related to the proposed prescribed fire treatments in alternative C only);
- fewer PACs attaining the desired post-treatment condition due to sequencing of treatments through time (all action alternatives);
- uncharacteristically dense forest conditions, fewer canopy openings, and fewer large pine and oak trees in restricted habitat that would be managed as threshold habitat where no resident MSOs exist on the Kaibab NF (all action alternatives);
- tree densities maintained well above the minimum basal area stand values recommended in the MSO recovery plan across all PACs, target, and threshold habitats (i.e., not using the best science available; alternative C only); and
- understory conditions would continue to decline across MSO habitat, affecting prey habitat and likely decreasing the total prey biomass for raptors.

Not including the amendment related to management of canopy cover and open reference conditions within ponderosa pine forest would prevent the ability to include rooting space necessary to sustain dense groups of trees, reduce forest densities and associated forest health (measured by the percent maximum SDI), and prevent the restoration of grasslands and savanna. This would decrease the ability to maintain dense groups of trees along with shrub and herbaceous vegetation, decreasing foods for herbivores, granivores (seed-eaters), insectivores, and so for carnivores as well. Grassland species and dispersing individuals of prey species (primarily rodents and lagomorphs) that aid in maintaining prey populations in forested habitat would be reduced as trees continue to encroach upon open habitats. Simultaneously, habitat for species that depend on closed canopy would gradually increase.

Not managing the proposed Garland Prairie Research Natural Area for the grassland characteristics it was intended to support would result in similar dynamics, i.e., the development of forest structural characteristics used by some species while reducing habitat effectiveness for open habitat species.

Currently, many of the MIS depend on habitats or habitat elements related to canopy openings or early seral conditions. Existing closed-canopy forests limit or eliminate many of the necessary habitat components needed by these species. The desired condition of closed canopy tree groups interspersed with open rooting space that supports herbaceous vegetation would provide key habitat components for these species of status as well as species adapted to closed-canopy forests. Achieving this situation is the reason for the amendments. This interspersion of habitats, which is a fundamental part of the desired condition, would not be attained without incorporating the amendments into the action alternatives.

Cumulative Effects for Management Indicator Species

The affected environment for cumulative effects varies by species (table 75). The analysis includes the combined impacts of all activities within the area as evaluated by each alternative. The effects of projects that already have been implemented were used to help describe current conditions of the project area and will not be discussed in this section. Ongoing and reasonably foreseeable activities are listed in the “Cumulative Effects” section in the wildlife report. Cumulative effects can be an integral part of the effects analysis for wildlife and are discussed for each species.

Table 75. Area of analysis for cumulative effects by species

Area of Analysis	Species	Reason for Selection
Within analysis area	Pygmy nuthatch, turkey, Abert’s squirrel, hairy woodpecker, red-naped sapsucker, juniper titmouse	Abert’s squirrel use limited areas centered on their nest trees. Birds may move to other areas, but their nesting habitat is the most limiting factor for these species.
½-mile around analysis area	Goshawk	The ½-mile buffer takes into account potential disturbance activities for these species found within the analysis area.
Game Management Unit (GMU)	Elk, mule deer, pronghorn	These species have wider mobility; GMUs are designed to encompass herd movements.

Alternative A

Coconino and Kaibab NFs

The cumulative effects of these treatments under the 4FRI “no action” alternative would improve the habitats of goshawk, pygmy nuthatch, turkey, hairy woodpecker, elk, mule deer, and Abert’s squirrel in the long term. Movement corridors and savannah treatments incorporated into ponderosa pine on the Kaibab NF would benefit pronghorn by creating forage and movement corridors. Aspen treatments would have limited effects to red-naped sapsuckers in the short term, but should improve habitat in the long term. Firewood gathering would affect the goshawk, pygmy nuthatch, hairy woodpecker, red-naped sapsucker, and juniper titmouse by removing snags and logs needed for nesting or prey species. Because only a small amount of pinyon-juniper habitat will be treated, impacts to populations of titmice are not expected. The proposed activities could benefit pronghorn locally by creating openings to support browse and improve landscape permeability. Right-of-way maintenance would benefit species that use open habitat like pronghorn, elk, and turkey by keeping liner strips of grassland open across the forest. These areas could also support prey species for goshawks. Right-of-way maintenance can also remove snags, logs, shrubs, and large trees, negatively affecting species tied to these habitat features such as the pygmy nuthatch, hairy woodpecker, and mule deer. Development on private lands, particularly in the grassland and savanna habitats, would reduce habitat quantity and quality and affect movement corridors for pronghorn, deer, and elk. Additionally, the exurban development and additional training ranges on the Navajo Army Depot would likely limit use by, and movement of, deer and elk in many of these areas.

In summary, the following cumulative effects apply to the MIS for both the Coconino and Kaibab NFs:

- For the goshawk and pronghorn, the improvement of habitat across the southern part of the forest would not change the forestwide habitat trend, but would help stabilize forestwide population trends.
- The forestwide habitat trend for the pygmy nuthatch would be improved by thinning projects that retain and enhance the large tree component within the ponderosa pine forest. This may help the forestwide population trend to stabilize.

- The tassel-eared squirrel, mule deer, elk, red-naped sapsucker, wild turkey, hairy woodpecker, and juniper titmouse forestwide population and habitat trends would not change.

Alternatives B, C, and D

Kaibab NF

The planned thinning and burning of 35,790 to 50,041 acres of ponderosa pine habitat would help reduce small tree densities and help move habitat toward historical stand structures. These treatments would have the same benefits discussed in alternative A, but when added to the additional treatments in the action alternative, would provide for improvement across the landscape. These treatments would affect the goshawk, pygmy nuthatch, turkey, hairy woodpecker, elk, mule deer, and Abert's squirrel by improving their habitats in the long term. The pygmy nuthatch forestwide habitat trend would be improved by thinning projects that retain and enhance the large tree component within the ponderosa pine forest. The ponderosa pine savanna treatments would benefit the pronghorn by creating forage and corridors for movement between areas.

The proposed aspen treatments are planned for areas that are a high priority for restoration. While this would only impact about 4 percent of the forest aspen, when combined with the proposed treatments in the action alternatives, these areas are most at risk of being lost in the near future. These treatments would have limited improvement of the red-naped sapsucker in the short term, but should improve their habitat in the long term.

Firewood gathering and travel management requirements together help determine where the public collects firewood. Since travel off-road is allowed in firewood areas only, this will limit how far the public will go to gather firewood. This will likely leave a high density of dead and down woody material in areas that are further from the road. Within firewood areas close to roads, less dead woody material will remain available and could fall below forest plan requirements for snags, logs, and dead and down woody material. Proposed treatments should help limit the amount of area not meeting forest requirements. This would affect the goshawk, pygmy nuthatch, hairy woodpecker, red-naped sapsucker, and juniper titmouse by removing snags that are needed for nesting or prey species. Pinyon-juniper thinning and burning, right-of-way maintenance, and development on private and other Federal lands would have the same impacts as described above for alternative A. The cumulative effects along with proposed activities in the action alternatives for MIS are as follows:

- For all the species, the cumulative effects of the above projects will not change the predicted forestwide habitat and population trends.

Coconino NF

The planned thinning and burning in ponderosa pine of 96,736 to 157,842 acres of ponderosa pine habitat would help reduce small tree densities and help move habitat toward historical stand structures. These treatments would have the same benefits discussed in alternative A, but when added to the additional treatments in the action alternative, they would provide for improvement across the landscape. These treatments would affect the goshawk, pygmy nuthatch, turkey, hairy woodpecker, elk, mule deer, and Abert's squirrel by improving their habitats in the long term.

The proposed aspen restoration is planned for areas that contain the majority of the aspen outside of the wilderness areas. This would impact 46 percent of the forest aspen clones. These treatments would have limited improvement of the red-naped sapsucker in the short term, but should improve habitat components in the long term. When combined with proposed treatments in the action alternatives, this would improve most of the aspen clones outside of wilderness areas.

Firewood gathering and travel management requirements together help determine where the public collects firewood. Off-road travel is only allowed for loading cut firewood. This would decrease miles driven off road by people scouting for firewood and would limit how much firewood is removed away from roads and increase firewood removal along roads. Proposed treatments should help limit the amount of area not meeting forest requirements. This would affect the goshawk, pygmy nuthatch, hairy woodpecker, red-naped sapsucker, and juniper titmouse by removing snags that are needed for nesting or prey species. Pinyon-juniper thinning and burning, right-of-way maintenance, and development on private and other Federal lands would have the same impacts as described above for the Kaibab NF.

The cumulative effects along with proposed activities in the action alternatives for MIS are as follows:

- For all species, the cumulative effects of the above projects would not change the predicted forestwide habitat and population trends.

Migratory Birds and Important Bird Areas (IBA)

Arizona Partners in Flight (APIF) identifies physiographic areas and priority migratory bird species by broad habitat types (Latta et al. 1999). In March 2008, the FWS released its 2008 “Birds of Conservation Concern Report” (USDI 2008). The Coconino and Kaibab NFs occur within the two bird conservation regions (BCR): the Southern Rockies/Colorado Plateau (BCR 16) and Sierra Madre Occidental (BCR 34). For the Kaibab NF, the treatment area only occurs within BCR 34. This analysis considered high priority bird species from both the APIF and the FWS birds of conservation concern (see wildlife specialist report). See the wildlife report which display acres of treatment by habitat type. Environmental consequences are based on the application of design features and mitigation. See the “Wildlife” section in appendix C in the DEIS.

Environmental Consequences

Ponderosa Pine Habitat Type

The following species are analyzed for this vegetation type: northern goshawk, flammulated owl, olive-sided flycatcher, Cordilleran flycatcher, Grace’s warbler, Lewis’s woodpecker, purple martin, and Cassin’s finch. All but the northern goshawk and purple martin would have potential removal of nesting habitat that would result in the potential to kill young of the year. Due to the low amount of removing nest habitat while young are still in the nest, there no measureable negative effects to any these birds’ populations from alternatives B, C, and D.

Aspen Habitat Type

The red-naped sapsucker is the only species within the aspen habitat. Only a small percentage of aspen or snags would be removed and not all removed trees would have active nest sites due to either not being nest trees or treatments occurring outside of breeding season. However, there would be potential of loss of young of the year. The removal of any eggs or fledgling would not result in a measurable negative effect to the red-naped sapsucker population from alternatives B, C, and D.

Pinyon-Juniper Habitat Type

The following species are analyzed for this vegetation type: gray vireo, pinyon jay, juniper titmouse, black-throated gray warbler, and gray flycatcher. There would be potential for young of the year being killed by removal of pinyon-juniper habitat through burning and mechanical treatment for these species. The project only occurs within less than 1 percent of the pinyon-juniper that occurs over both forests. Not all treatments would occur during the breeding season. The removal of any eggs or fledgling would not result in a measurable negative effect any of these species' population from alternatives B, C, and D.

High Elevation Grasslands Habitat Type

The following species are analyzed for this vegetation type: Swainson's hawk, ferruginous hawk, burrowing owl, grasshopper sparrow, and Bendire's thrasher. Only the burrowing owl, grasshopper sparrow, and Bendire's thrasher have potential for mechanical treatments of removing nest with young of year, or for the grasshopper sparrow and Bendire's thrasher the loss of nest sites through burning. Due to the limited amount of habitat that would be affected by implementation of the project and not all habitat would be affected during the nesting season, it would not result in a measurable negative effect on any of these species' populations from alternatives B, C, and D.

Forest Plan Amendments

Not incorporating these amendments would affect the habitat of most of the migratory birds addressed in this report (see the wildlife report for complete analysis). Not including the amendments would not be expected to affect the Anderson Mesa Important Bird Area (IBA). The MSO amendments would allow managing for lower tree densities and basal area, creating canopy gaps, creating and sustaining more large pine and oak trees in the long-term, more large snags through time, and increasing understory response. Not incorporating these amendments would allow:

- uncharacteristically dense forest conditions, fewer big pine and oak trees, and increased fire risk for wildlife using forested habitats in 18 PACs (related to the proposed mechanical treatments in all action alternatives);
- uncharacteristically dense forest conditions, lower crown base height, and increased fire risk in 56 PACs (related to the proposed prescribed fire treatments in alternative C only);
- fewer PACs attaining the desired post-treatment condition due to sequencing of treatments through time (all action alternatives);
- uncharacteristically dense forest conditions, fewer canopy openings, and fewer large pine and oak trees in restricted habitat that would be managed as threshold habitat where no resident MSOs exist on the Kaibab NF (all action alternatives);

- tree densities maintained well above the minimum basal area stand values recommended in the draft recovery plan across all PACs, target, and threshold habitats (i.e., not using the best science available; alternative C only); and
- understory conditions would continue to decline across MSO habitat, affecting prey habitat and likely decreasing the total prey biomass for raptors.

Not including the amendment related to management of canopy cover and open reference conditions within ponderosa pine forest would prevent the ability to include rooting space necessary to sustain dense groups of trees, reduce forest densities and associated forest health (measured by the percent maximum SDI), and prevent the restoration of grasslands and savanna. This would decrease the ability to maintain dense groups of trees along with shrub and herbaceous vegetation, decreasing foods for herbivores, granivores (seed-eaters), insectivores, and so for carnivores as well. Grassland species and dispersing individuals of prey species (primarily rodents and rabbits/hares) that aid in maintaining prey populations in forested habitat would be reduced as trees continue to encroach upon open habitats. Simultaneously, habitat for species that depend on closed canopy would gradually increase.

Not managing the proposed Garland Prairie Research Natural Area for the grassland characteristics it was intended to support would result in similar dynamics, i.e., the development of forest structural characteristics used by some species while reducing habitat effectiveness for open habitat species.

Currently, many migratory birds depend on habitats or habitat elements related to canopy openings or early seral conditions. Existing closed-canopy forests limit or eliminate many of the necessary habitat components needed by these species. The desired condition of closed canopy tree groups interspersed with open rooting space that supports herbaceous vegetation would provide key habitat components for these species of status as well as species adapted to closed-canopy forests. Achieving this situation is the reason for the amendments. This interspersion of habitats, which is a fundamental part of the desired condition, would not be attained without incorporating the amendments into the action alternatives.

Cumulative Effects for Migratory Birds

Because of their seasonal movement, the primary management concern for migratory birds is nesting habitat and, for bald eagles, winter roost sites. The cumulative analysis area for migratory birds is the project area. Past, present, and reasonably foreseeable activities are listed in appendix 12 of the wildlife report. The effects of projects already implemented were used to describe existing conditions of the project area and will not be discussed in this section.

There is an estimated 86,290 acres of thinning from other projects within the treatment area that would thin ponderosa pine habitat. There is an estimated 153,211 acres of burning in the treatment area. There would also be 4,416 acres of ponderosa pine savanna restoration occurring on the Kaibab NF. There are 683 acres of planned aspen restoration and subsequent barrier construction planned on the Kaibab NF and 4,637 acres of planned aspen restoration with associated barriers on the Coconino NF. In total, 5,320 acres of aspen restoration are planned or ongoing within the 4FRI analysis area.

Both the Coconino and Kaibab NFs have begun implementing travel management within the treatment area. These efforts would affect impacts from firewood cutting, hunting, and recreational camping across both forests. On the Coconino NF, the public is allowed to travel cross country to collect cut firewood with the proper permit. On the Kaibab NF, the public is only allowed to drive off-road to collect firewood within designated areas. While there are species-specific rules for cutting dead trees, it is not uncommon for larger snags to be cut. This occurs in areas closer to roads and decreasing miles of open road should decrease the loss of the resource. The Kaibab NF will allow for retrieval of elk during hunting season in all GMUs while the Coconino NF will allow elk retrieval in all GMUs except 5a and 5b. The Coconino NF designated 300-foot-wide off-road camping corridors on select roads for people wanting to park vehicles away from roads. On the Coconino NF, areas without camping corridors will have parking allowed up to 30 feet off of roads. The Kaibab NF will allow vehicle parking up to 30 feet away from all open roads but does not have designated areas for driving off-road beyond that distance for camping.

The Kaibab and Coconino NFs have planned 7,040 acres of pinyon-juniper to be treated within the project area. Grassland restoration treatments include removal of encroaching conifers and prescribed fire to rejuvenate grasses and forbs. Within the project areas, there are 9,840 acres of planned grassland treatments.

Both forests have ongoing maintenance of utility rights-of-way (power and gas lines). This involves thinning and burning within the rights-of-way to keep the area clear of trees and shrubs. Utility rights-of-way include 32,344 acres, with the majority of the area on the Coconino NF.

Grazing is occurring through the project area on both forests. Grazing is an ongoing activity and the timing of season of use varies by allotment. On average, 30 to 40 percent of the forage is allowed for utilization by livestock and wildlife. There is no proposal to increase any livestock numbers within these allotments. Therefore, there is no additional affects beyond existing conditions.

There are approximately 150,000 acres of non-Forest Service administered lands within the project area. These areas include housing tracts, Navajo Army Depot, vacation homes, and ranchland. The Navajo Army Depot is planning development of new training ranges and thinning and prescribed fire. The Department of Defense is planning 17,049 acres of thinning and burning in ponderosa pine and some grasslands restoration. The Greater Flagstaff Forest Partnership is planning to burn and thin 535 acres of ponderosa pine habitat around the Flagstaff area.

Alternatives B, C, and D

Resulting forest structure from planned thinning and burning of 243,917 acres of ponderosa pine habitat outside of the 4FRI should result in habitat resembling the historical range of variation. In the long term, wildlife species are less likely to be adversely affected by treatments that result in habitat conditions consistent with those of their evolutionary past and so are expected to respond positively to the ongoing and proposed thinning projects (Kalies et al. 2010). These treatments would improve habitat for most birds species associated with the ponderosa pine cover type in the long term (e.g., bark gleaners, woodpeckers, and flycatchers), but may negatively affect foliage gleaners in the short term (Patton and Gordon 1995, George et al. 2005).

The proposed aspen restoration is planned for areas that are a high priority for restoration on both forests. Cumulatively, this would treat the aspen outside of wilderness that are at most risk of being lost in the near future. These treatments would yield limited improvements for the red-naped sapsucker in the short term, but should improve their habitat components in the long term.

Firewood gathering and travel management requirements together help determine where the public collects firewood. The public will be limited in where they can travel off road to gather firewood on both the Coconino and Kaibab NFs. This would likely leave higher densities of dead and down woody material in areas further from roads. Less dead woody material would be expected to remain within firewood areas and areas closer to roads. Designated firewood areas on the Kaibab NF may not always meet forest plan requirements for woody material once wood gathering activities occur. Areas adjacent to roads may be deficit on the Coconino NF. This could have a negative effect on species that use snags or down material in the ponderosa pine, aspen, and pinyon-juniper. In grasslands, the travel management requirements would benefit grassland species by preventing cross-country travel in their habitat.

Pinyon-juniper thinning and burning has the potential to both remove habitat and improve habitat for birds that use this habitat type. The proposed activities could result in loss of young of year depending on timing of activities. The effects to pinyon-juniper associated species are expected to be limited because only a small amount of this habitat would be treated within the cumulative effects analysis area.

Utility right-of-way maintenance would help keep strips of land open and create the equivalent of relatively narrow, liner grasslands. While this may affect individual birds, there is not likely to be a cumulative effect to any species because of the limited space and spatial configuration of this habitat.

Development on private land and other Federal lands continue to remove habitat within and adjacent to the project area. With development of the additional training ranges on the Navajo Army Depot, this will likely move more species out of the area. The cover type with the most development occurring is within grasslands and savanna habitat. This would reduce the amount of habitat.

The Coconino NF has implemented an innovative management strategy to protect wetlands from grazing and prolonged drought within the Anderson Mesa IBA by regulating the timing and duration of livestock grazing in permitted areas. Wetlands are being protected from livestock by constructing fences that still allow passage of wildlife. Habitat restoration, including the restoration of grasslands, is in progress. Ranchers are actively engaged through the Diablo Trust and numerous conservation organizations have assisted in achieving conservation objectives for the site.

The cumulative effects for migratory birds could result in some incidental mortality caused by project implementation activities. How much mortality would be proportional to how many acres are treated during the spring nesting season of April, May, June, and July. Seasonal restrictions would limit project implementation activities between March 1 and September 30 in goshawk nest area and PFAs and within MSO PACs, which would reduce potential of loss for species listed in ponderosa pine habitat. Prescribed burning occurs also in the fall, outside of the spring nesting season. Since only a small percentage of habitats would be treated at any one time, the loss of eggs or nestlings would not result in a measurable negative effect to the migratory birds populations listed above.

Other Forest Plan Required Analyses

Hiding and Thermal Cover

Providing for hiding and thermal cover is required by both forest plans. Both plans direct at least 10 percent hiding cover and 10 percent thermal cover be provided in assessment areas. An additional 10 (Coconino NF) to 20 percent (Kaibab NF) of cover can be classified as either hiding or thermal (unless the needs of species listed as threatened or endangered under the ESA conflicts with this direction) (USDA 1987, 1988). Wildlife cover on the Coconino NF should be assessed in 10,000-acre blocks while the Kaibab describes cover assessments in terms of project areas. Both are intended to ensure that cover is provided across the area under consideration and not concentrated in some regions and absent from others. However, neither scale meets the intent of the forest plans when applied to the 4FRI treatment area. Ten-thousand-acre blocks are small relative to 4FRI and the project area is too large. Therefore, wildlife cover was evaluated at the subunit scale, allowing for an assessment of unit areas fully distributed across the treatment area.

The size of tree groups and canopy cover developed for the 4FRI are from the scientific literature and site conditions assigned by the terrestrial ecosystem survey. The resulting forest structure is designed to meet or move toward forest plan direction (e.g., even-aged stands cannot attain uneven-aged conditions in a single entry). This approach does incorporate the best science available to better meet the intent of the forest plans. Because this approach meets the intent of the forest plans, no forest plan amendment was needed. Final assessments for cover categories included a combination of treatment intensity, VSS category, canopy cover, and woody plant species other than pine. All data and documentation related to hiding and thermal cover is located in appendix 5 of the wildlife specialist report, and analysis details can be found on pages 17 to 19 of the wildlife report.

Habitat Capability

The NFMA directs the Forest Service to maintain enough habitat adequately distributed across each forest to maintain populations of designated MIS. Habitat capability index (HCI) modeling was not used in the 4FRI wildlife analyses because the HCI approach does not meet direction for use of the best available science. Instead, ecosystem management can be viewed in terms of the evolutionary environment or range of natural variability under which habitats and their associated species evolved (Fulé et al. 2002, Abella 2008). This analysis compared MIS habitat elements such as early seral habitat, late-seral habitat, or large snags, to the desired conditions specifically developed to represent the historical range of variation.

The comparison of habitat elements was done among alternatives and through time using the FVS. Although the HCI model was not specifically used (forest-specific models are no longer available on either the Coconino or Kaibab NFs), the approach used in this analysis is consistent with the intent of the forest plans in terms of maintaining appropriate habitats on the landscape. All data related to assessing a surrogate for HCI is located in MIS effects analysis (see wildlife report).

Other Analysis

Habitat Connectivity

Using the vegetation analysis, the wildlife analysis evaluated potential impacts to habitats from treatments in alternatives B, C, and D. A full discussion of bridge habitat for canopy-dependent wildlife can be found in appendix G of the DEIS and in appendix 3 of the wildlife report. In addition, landscape-scale closed canopy corridors would be included as part of each action alternative (see appendix 4 of the wildlife report).

Environmental Consequences – Alternatives B, C, and D

In alternatives B, C, and D, 13 percent of the landscape within the 4FRI project boundary would be deferred from treatment. Nearly 42 percent of the ponderosa pine treatment area would have a moderately closed canopy and another 17 percent would remain in a closed condition after treatment. An additional 17 percent of the treated area would have a mix of open and closed conditions. Restoration units near the Mogollon Rim would provide the greatest percentage of bridge habitat after treatment. Old growth allocations account for 38 percent of the ponderosa pine treatment area and are well distributed across the landscape.

A patch-mosaic of small deferrals would be created in stands all across the 4FRI project area to provide safeguards for wildlife features such as nests and hiding cover. Implementation guidance in MSO and northern goshawk habitats includes provisions for higher density and canopy cover.

Aquatics

This section includes key effects and conclusions for aquatic threatened, endangered, and proposed species and critical habitat listed under the Endangered Species Act of 1973, as amended, Forest Service Southwestern Region sensitive species, and Coconino and Kaibab NFs aquatic management indicator species (MIS).

The fisheries specialist (Childs 2013) report is incorporated by reference. See the specialist report for detailed information on methodology, analysis assumptions, best available science and data, habitats, populations, and effects that are not repeated in this section.

Aquatic Federally Listed Threatened, Endangered, Proposed Candidate Species, and Designated Critical Habitat, and Forest Service Sensitive Species

Only those aquatic federally listed threatened, endangered, candidate species along with Forest Service sensitive species that are known or have potential to occur within the project area are analyzed. Table 76 lists species considered and provides a summarized existing condition narrative. Table 77 describes the affected environment for species evaluated.

The threatened, endangered, and sensitive species lists for the Coconino NF was reviewed and a list of species was created for this project based on known occurrence or, in the absence of survey data, the presence of suitable habitat. The following is a description of the species, their habitat, and an analysis of the effects of implementation of each alternative on each species.

Three species (Gila chub, razorback sucker, and Colorado pikeminnow) were eliminated from further analysis because these species do not have critical habitat, potential habitat, or occupied habitat in the analysis area. Gila trout was eliminated from further analysis because this species does not have occupied habitat in the analysis area, and because this species will not be reintroduced into any waters in the analysis area in the foreseeable future.

Table 76. Aquatic threatened, endangered, candidate, and sensitive species evaluated in this analysis

Common Name	Scientific Name	Status[1]	Occurrence[2]	Coconino NF Forestwide Habitat (miles)	Potential Habitat in Affected Environment (miles)	Occupied Habitat in Affected Environment (miles)
Fish						
Gila chub	*Gila intermedia*	E, WC	Δ	13.3[4]	0	0
Spikedace	*Meda fulgida*	E, WC	Δ	134.3[4]	36.8[4]	0
Colorado pikeminnow	*Ptychocheilus lucius*	E[3], WC	Δ	55.6	0	0
Loach minnow	*Tiaroga cobitis*	E, WC	H	95.8[4]	36.8[4]	0
Razorback sucker	*Xyrauchen texanus*	E, WC	Δ	55.6[4]	0	0
Roundtail chub	*Gila robusta*	C, WC, FS-S	O, Δ	350.9	77.9	77.9
Longfin dace	*Agosia chrysogaster*	WC, FS-S	O, Δ	236.7	77.9	77.9
Desert sucker	*Catostomus clarki*	WC, FS-S	O, Δ	236.7	77.9	77.9
Sonora sucker	*Catostomus insignis*	WC, FS-S	O, Δ	236.7	77.9	77.9
Macroinvertebrates						
California floater	*Anodonta californiensis*	FS-S	H	368.6	77.9	0
A mayfly	*Homoleptohyphes quercus*	FS-S	O	77.7	72.6	72.6

[1] Status: T = Federally listed as threatened, E = Federally listed as endangered, C = Candidate for Federal listing as threatened or endangered, WC = Wildlife of special concern in Arizona (1996 AGFD classification pending revision to Article 4 of the State regulations), FS-S = Forest Service sensitive species
[2] Occurrence: O = Species known to occur in the project area or in the general vicinity of the area, Δ = Species occurs downstream of project area, H = Species occurred historically in project area
[3] Colorado pikeminnow is listed as endangered; the species is listed as "experimental nonessential" in Arizona.
[4] All habitat is also critical habitat.

Table 77. Aquatic threatened, endangered, candidate, sensitive, and MIS species evaluated in this analysis and their affected anvironment

Common (Scientific Name)	Affected Environment
Threatened and Endangered Aquatic Species	
Spikedace (*Meda fulgida*) and critical habitat	Spikedace is historic to the Verde River. However, the species has not been detected for years in this system and may be extirpated. There are 134.3 miles of spikedace critical habitat within the Coconino NF boundary. Within the analysis area, the species has 36.8 miles of critical habitat, in the middle and lower Oak Creek. Although unoccupied, this habitat is analyzed for potential effects from the proposed alternatives.
Loach Minnow (*Tiaroga cobitis*) and critical habitat	Loach minnow has been extirpated from the Verde River, and it has not been detected in that stream since 1938 (Minckley 1993). There are 95.8 miles of loach minnow critical habitat within the Coconino NF boundary. Within the analysis area, the species has 36.8 miles of critical habitat, in the middle and lower Oak Creek. Although unoccupied, this habitat is analyzed for potential effects from the proposed alternatives.
Aquatic Candidate Species	
Roundtail Chub (*Gila robusta*)	Roundtail chub is widespread in moderate to large rivers of the Colorado River Basin. In Arizona, it still occurs in the main stem and tributaries to the Verde and Salt Rivers. There are 350.9 miles of potential roundtail chub habitat within the Coconino NF boundary. Within the analysis area, the species occupies 77.9 miles (22.2 percent) of perennial streams, including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek.
Southwestern Region Forest Service Aquatic Sensitive Species	
Longfin Dace *(Agosia chrysogaster)*	There are 236.7 miles of potential longfin dace habitat within the Coconino NF boundary. Within the analysis area, the species occupies 77.9 miles (32.9 percent) of perennial streams, including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek.
Desert Sucker *(Catostomus clarki)*	There are 236.7 miles of potential desert sucker habitat within the Coconino NF boundary. Within the analysis area, the species occupies 77.9 miles (32.9 percent) of perennial streams, including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek.
Sonora Sucker *(Catostomus insignis)*	There are 236.7 miles of potential Sonora sucker habitat within the Coconino NF boundary. Within the analysis area, the species occupies 77.9 miles (32.9 percent) of perennial streams, including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek.
California Floater *(Anodonta californiensis)*	There are 368.6 miles of potential California floater habitat within the Coconino NF boundary. Within the analysis area, there are 77.9 miles (21.1 percent) of potential perennial stream habitat, including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek.
A Mayfly *(Homoleptohyphes quercus)*	There are 77.7 miles of potential A mayfly habitat within the Coconino NF boundary. Within the analysis area, the species occupies 72.6 miles (93.4 percent) of perennial streams, including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, and West Fork of Oak Creek.

Common (Scientific Name)	Affected Environment
Aquatic Management Indicator Species (MIS)	
Macroinvertebrates	As a group, aquatic macroinvertebrates are identified in both the Coconino NF and Kaibab NF forest plans (as amended) as MIS for high and low elevation late-seral riparian areas. There are 368.6 miles of potential macroinvertebrate habitat within the Coconino NF boundary. Within the analysis area, macroinvertebrates occupy 83.7 miles (22.7 percent) of perennial streams, including Munds Canyon, Oak Creek, Pumphouse Wash, Rio de Flag, Sawmill Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek.

Environmental Consequences

Potential impacts to aquatic resources are compared to the sediment outputs predicted in the soils and hydrology specialist report (Steinke 2013, MacDonald 2013). The primary environmental consequence to aquatic habitat and associated species from timber and vegetation treatments would be increased ground disturbance which has the potential to increase the rate of soil erosion over natural background levels. The analysis focuses on the predicted ground disturbance and its effect in regards to the following:

- Changes in sediment and erosion.
- Alterations to channel morphology—increased sediment has the potential to alter stream channel morphology.
- Changes to stream temperatures—alterations in morphology can change the width to depth ratio of channels, and shallower wider channels can lead to more drastic diurnal fluctuation in stream temperature and higher and lower temperature extremes.
- Effects on riparian vegetation—loss of upland watershed vegetation can lead to flashier hydrographs which erode stream channels, lowering the water table impacting riparian vegetation.
- Macroinvertebrate assemblage—alteration in channel morphology or increases in sediment can alter the macroinvertebrate assemblage.

Stream Habitat

Alternative A

It is predicted (Lata 2013) that up to 33 percent of soils could burn under high burn severity if left untreated and the soils analysis indicates there would be erosion above the tolerance level and a loss of soil productivity. The result to stream courses and perennial streams, including their threatened, endangered, and sensitive species and habitat, would be effects similar to those observed following the Schultz Fire in 2010 (flooding, soil erosion, debris flows, channel realignment, destruction of riparian areas, sedimentation, and embeddedness of stream substrates, etc.).

The effects of increased sedimentation on fishes include ash flows that can negatively impact water quality by increasing pH and decreasing dissolved oxygen levels (Earl and Blinn 2003), both of which can quickly kill fish. Alternative A would not mitigate these potential negative impacts.

However, it is difficult to compare the known effects of the proposed action alternatives with the potential effects of hypothetical wildfire. Because there are no direct or indirect effects to threatened, endangered, or sensitive species or their habitat from alternative A, there would be no cumulative effects.

Effects Common to Alternatives B, C, and D

Direct effects of vegetation management on stream systems should be minor when Forest Service BMPs are followed (Southwestern Region FSH 2509.22) (see appendix C of the DEIS for all mitigation and BMPs). Limiting vegetation management activities from impacting stream courses should lead to minor or inconsequential direct effects to streams habitat and their associated biota. Buffer strips of at least 70 feet to 120 feet (BMP 8; Steinke 2013) would be used to protect stream courses.

None of the action alternatives propose for ignitions to occur within riparian areas or along stream channels, but fire would be allowed to back downslope into these areas. If fire burns riparian areas, there is the potential for some ash and localized erosion to occur, however, these effects should be minor in degree and extent.

All action alternatives propose some prescribed fire on slopes greater than 15 percent, so there would be a short-term risk of sedimentation or ash flow resulting from these treatments. However, BMPs would be in place to mitigate these risks and proposed treatments would occur over a 10-year period, rather than all at once, so any impacts should be localized in extent.

The primary negative impacts to aquatic systems and their associated biota from vegetation treatment and prescribed fire come as indirect effects including: increased sediment, loss of riparian vegetation, altered macroinvertebrate assemblages, lowering of groundwater tables and decreased perennial flows, increased stream temperature, larger peak flows, stock tank impacts, and changes in channel form (Bisson et al. 2003, Swank et al. 1989).

There would be an increased risk of sediment and ash flow into stream courses in alternative B and C over alternative D, which has less prescribed fire.

The perennial streams within the project area that contain fish and/or macroinvertebrates are Munds Canyon, Oak Creek, Pumphouse Wash, Rio de Flag, Sawmill Wash, Sterling Canyon, Sycamore Creek, and West Fork Oak Creek (see specialist report). Effects from the action alternatives to aquatic resources are compared with regard to sediment outputs predicted from the soils and water quality and riparian specialist's report (Steinke 2013, MacDonald 2013).

BMPs should greatly reduce the risk to perennial streams of short-term impacts (sedimentation) from prescribed fire activities. BMPs would also reduce the risk of short-term impacts resulting from spring and stream restoration, road decommissioning, and dust abatement measures.

Forest Plan Amendments

Effects from the proposed forest plan amendments would not be measurable to aquatic species or their habitat.

Threatened, Endangered, and Forest Service Sensitive Aquatic Species Habitat

Threatened, endangered, and Forest Service sensitive aquatic species in and adjacent to the project area are all located on the Coconino NF. Units and subunits (and relevant 6th Code HUC watersheds) that contain these species are: 1-3 (Pumphouse Wash), 1-4 (Sawmill Wash), 1-5 (Munds Canyon), 3-3 (Cedar Creek, Little LO Spring Canyon, Lower Sycamore Creek, Middle Sycamore Creek, Upper Sycamore Creek), 3-4 (Pumphouse Wash), 3-5 (Middle Oak Creek, Munds Canyon, Upper Oak Creek, West Fork Oak Creek), and 5-1 (Lower Rio de Flag). All other watersheds within the analysis area do not contain threatened, endangered, and sensitive aquatic species habitat. Table 78 displays the environmental consequences of the proposed alternatives.

Cumulative Effects

The geographic setting and boundary for the cumulative effects analysis is the 82 6th HUC watersheds within or intersecting the project boundary for a total of about 2,032,000 acres. The timeframe for past actions is 2 to 3 years based on vegetative and CWD recovery of the site.

The cumulative impacts to soils and watershed from past, present, and reasonably foreseeable actions as presented in the “Soils and Water” section of chapter 3 and the soils specialist report is incorporated by reference.

Table 78. Aquatic threatened, endangered, candidate, and sensitive species environmental consequences

Species	Alternative A	Alternatives B, C, and D
Threatened and Endangered Aquatic Species		
Spikedace and critical habitat Loach Minnow and critical habitat	**Species Determination** Spikedace and loach minnow are not currently present within the affected environment. Therefore, alternative A would have **no effect** on spikedace or loach minnow. **Critical Habitat** Within the analysis area, critical habitat for spikedace and loach minnow exists in the middle and lower portions of Oak Creek (USDI 2012). Perennial streams on the Coconino NF within and adjacent to the project area are at high risk of increased sedimentation and ash flows resulting from stand-replacing crown fires. Ash flows produced from forest fires can negatively impact water quality. Stream morphology can be changed by sediment deposition. Alternative A (no action) would not mitigate these potential negative impacts. However, it is difficult to compare the known effects of the proposed action alternatives with the potential effects of hypothetical wildfire. Because there are no direct or indirect effects to spikedace and loach minnow or their habitat from alternative A, there would be no cumulative effects. Therefore, alternative A would have **no effect** on spikedace or loach minnow critical habitat.	**Species Determination** Spikedace and loach minnow are not currently present within the affected environment. Therefore, alternative B would have **no effect** on spikedace or loach minnow. **Critical Habitat** Within the analysis area, critical habitat for spikedace and loach minnow exists in the middle and lower portions of Oak Creek (USDI 2012). The soils report (Steinke 2013) indicates that prescribed fire treatments could result in soil erosion in areas where slope exceeds 15 percent. There would be a short-term risk (1–2 years) of sedimentation or ash flow resulting from these treatments. However, BMPs would be in place to mitigate these risks and proposed treatments would occur over a 10-year period, rather than all at once, so any impacts should be localized in extent. Alternative C proposes more acres of mechanical vegetation treatment than alternative B, but vegetation treatments should result in negligible soil erosion if BMPs are followed. Alternative D proposes far fewer acres of prescribed fire than either alternative B or C, but alternative D would not meet the purpose and need of the project. The short-term risks incurred by the proposed vegetation treatments and prescribed fire are necessary for the long-term benefit of the forest, including restoring the health of watersheds and streams in which spikedace and loach minnow live. Spring and stream restoration, as well as road decommissioning activities, could also result in short-term increases in soil movement and sedimentation. These proposed treatments are the same across all action alternatives. Again, BMPs would be in place to mitigate these short-term risks in order to see long-term benefits from restored hydrologic function at spring sources, reduced potential for severe flooding in restored ephemeral channels, and reduced erosion and runoff resulting from properly decommissioned and/or relocated roads. Therefore, considering direct, indirect, and cumulative effects, alternatives B, C, and D **may affect but are not likely to adversely affect** spikedace or loach minnow critical habitat.

Species	Alternative A	Alternatives B, C, and D
Candidate Species		
Roundtail Chub	**Species Determination** Within the analysis area, roundtail chub occupies 77.9 miles of perennial stream (22.2 percent of its habitat on the Coconino NF), including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek. Perennial streams on the Coconino NF within and adjacent to the project area are at high risk of increased sedimentation and ash flows resulting from stand-replacing crown fires. Ash flows produced from forest fires can negatively impact water quality. Stream morphology can be changed by sediment deposition. Alternative A would not mitigate these potential negative impacts. However, it is difficult to compare the known effects of the proposed action alternatives with the potential effects of hypothetical wildfire. Because there are no direct or indirect effects to roundtail chub or its habitat from alternative A, there would be no cumulative effects. Therefore, alternative A would have **no effect** on roundtail chub or its habitat.	**Species Determination** Within the analysis area, roundtail chub occupies 77.9 miles of perennial stream (22.2 percent of its habitat on the CNF), including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek. The soils report (Steinke 2013) indicates that prescribed fire treatments could result in soil erosion in areas where slope exceeds 15 percent. There would be a short-term risk (1–2 years) of sedimentation or ash flow resulting from these treatments. However, BMPs would be in place to mitigate these risks and proposed treatments would occur over a 10-year period, rather than all at once, so any impacts should be localized in extent. Alternative C proposes more acres of mechanical vegetation treatment than alternative B, but vegetation treatments should result in negligible soil erosion if BMPs are followed. Alternative D proposes far fewer acres of prescribed fire than either alternative B or alternative C, but alternative D would not meet the purpose and need of the project. The short-term risks incurred by the proposed vegetation treatments and prescribed fire are necessary for the long-term benefit of the forest, including restoring the health of watersheds and streams in which roundtail chub live. Spring and stream restoration, as well as road decommissioning activities could also result in short-term increases in soil movement and sedimentation. These proposed treatments are the same across all action alternatives. BMPs would be in place to mitigate these short-term risks in order to see long-term benefits from restored hydrologic function at spring sources, reduced potential for severe flooding in restored ephemeral channels, and reduced erosion and runoff resulting from properly decommissioned and/or relocated roads. Therefore, considering direct, indirect, and cumulative effects, alternatives B, C, and D **may affect but are not likely to adversely affect** roundtail chub or its habitat.
Southwestern Region Forest Service Sensitive Species*		
Roundtail Chub	**Species Determination** Within the analysis area, roundtail chub occupies 77.9 miles of perennial stream (22.2 percent of its habitat on the CNF), including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek. Perennial streams on the Coconino NF within and	**Species Determination** Within the analysis area, roundtail chub occupies 77.9 miles of perennial stream (22.2 percent of its habitat on the CNF), including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek. The soils report (Steinke 2013) indicates that prescribed fire treatments could result in soil erosion in areas where slope exceeds 15 percent. There would be a short-term risk (1–2 years) of sedimentation or ash flow resulting from these treatments. However, BMPs would

Species	Alternative A	Alternatives B, C, and D
	adjacent to the project area are at high risk of increased sedimentation and ash flows resulting from stand-replacing crown fires. Ash flows produced from forest fires can negatively impact water quality. Stream morphology can be changed by sediment deposition. Alternative A would not mitigate these potential negative impacts. However, it is difficult to compare the known effects of the proposed action alternatives with the potential effects of hypothetical wildfire. Because there are no direct or indirect effects to roundtail chub or its habitat from alternative A, there can be no cumulative effects. Therefore, alternative A is **not likely to cause a trend to Federal listing or loss of viability** of roundtail chub.	be in place to mitigate these risks and proposed treatments would occur over a 10-year period, rather than all at once, so any impacts should be localized in extent. Alternative C proposes more acres of mechanical vegetation treatment than alternative B, but vegetation treatments should result in negligible soil erosion if BMPs are followed. Alternative D proposes far fewer acres of prescribed fire than either alternative B or C, but alternative D would not meet the purpose and need of the project. The short-term risks incurred by the proposed vegetation treatments and prescribed fire are necessary for the long-term benefit of the forest, including restoring the health of watersheds and streams in which roundtail chub live. Spring and stream restoration, as well as road decommissioning activities, could also result in short-term increases in soil movement and sedimentation. These proposed treatments are the same across all action alternatives. BMPs would be in place to mitigate these short-term risks in order to see long-term benefits from restored hydrologic function at spring sources, reduced potential for severe flooding in restored ephemeral channels, and reduced erosion and runoff resulting from properly decommissioned and/or relocated roads. Therefore, considering direct, indirect, and cumulative effects, alternatives B, C, and D **may impact individuals, but are not likely to cause a trend to Federal listing or loss of viability** of roundtail chub.
Longfin Dace Desert Sucker Sonora Sucker California Floater	**Species Determination** Within the analysis area, longfin dace, desert sucker, and Sonora sucker occupy 77.9 miles of perennial stream (32.9 percent of its habitat on the Coconino NF), including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek. These perennial streams also represent potential habitat for the extirpated California floater. Perennial streams on the Coconino NF within and adjacent to the project area are at high risk of increased sedimentation and ash flows resulting from stand-replacing crown fires. Ash flows produced from forest fires can negatively impact water quality. Stream morphology can be changed by sediment deposition. Alternative A (no action) would not mitigate these potential negative impacts. However, it is difficult to	**Species Determination** Within the analysis area, longfin dace, desert sucker, and Sonora sucker occupy 77.9 miles of perennial stream (32.9 percent of its habitat on the Coconino NF), including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek. These perennial streams also represent potential habitat for the extirpated California floater. The soils report (Steinke 2013) indicates that prescribed fire treatments could result in soil erosion in areas where slope exceeds 15 percent. There would be a short-term risk (1–2 years) of sedimentation or ash flow resulting from these treatments. However, BMPs would be in place to mitigate these risks and proposed treatments would occur over a 10-year period, rather than all at once, so any impacts should be localized in extent. Alternative C proposes more acres of mechanical vegetation treatment than alternative B, but vegetation treatments should result in negligible soil erosion if BMPs are followed. Alternative D proposes far fewer acres of prescribed fire than either alternative B or C, but alternative D does not meet the purpose and need of the project. The short-term risks incurred by the proposed vegetation treatments and prescribed fire are

Species	Alternative A	Alternatives B, C, and D
	compare the known effects of the proposed action alternatives with the potential effects of hypothetical wildfire. Because there are no direct or indirect effects to longfin dace, desert sucker, Sonora sucker, or California floater or their habitat from alternative A, there can be no cumulative effects. Therefore, alternative A is **not likely to cause a trend to Federal listing or loss of viability** of longfin dace, desert sucker, Sonora sucker, or California floater.	necessary for the long-term benefit of the forest, including restoring the health of watersheds and streams in which longfin dace, desert sucker, and Sonora sucker live. Spring and stream restoration, as well as road decommissioning activities, could also result in short-term increases in soil movement and sedimentation. These proposed treatments are the same across all action alternatives. BMPs would be in place to mitigate these short-term risks in order to see long-term benefits from restored hydrologic function at spring sources, reduced potential for severe flooding in restored ephemeral channels, and reduced erosion and runoff resulting from properly decommissioned and/or relocated roads. Therefore, considering direct, indirect, and cumulative effects, alternatives B, C, and D **may impact individuals, but are not likely to cause a trend to Federal listing or loss of viability** of longfin dace, desert sucker, Sonora sucker, or California floater.
A mayfly	**Species Determination** There are 77.7 miles of potential A mayfly habitat within the Coconino NF boundary. Within the analysis area, the species occupies 72.6 miles (93.4 percent) of perennial stream, including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, and West Fork of Oak Creek. It is often associated with silt, fine sand, gravel, and woody debris. It is not thought that sediment impairs this species or its habitat and there is no clear understanding as to why this species range has declined. Since there are no direct or indirect effects to A mayfly from alternative A, there would be no cumulative effects. Therefore, alternative A is **not likely to cause a trend to Federal listing or loss of viability** of A mayfly.	**Species Determination** There are 77.7 miles of potential A mayfly habitat within the Coconino NF boundary. Within the analysis area, the species occupies 72.6 miles (93.4 percent) of perennial stream, including Munds Canyon, Oak Creek, Pumphouse Wash, Sterling Canyon, and West Fork of Oak Creek. It is often associated with silt, fine sand, gravel, and woody debris. It is not thought that sediment impairs this species or its habitat, and there is no clear understanding as to why this species range has declined. Since there are no direct or indirect effects to A Mayfly from alternatives B–D, there would be no cumulative effects. Therefore, alternatives B–D are **not likely to cause a trend to Federal listing or loss of viability** of A mayfly.

Species	Alternative A	Alternatives B, C, and D
Management Indicator Species		
Macroinvertebrates High and Low Elevation Late-seral Riparian Indicator Species	**Determination** There are 368.6 miles of potential macroinvertebrate habitat (perennial stream) within the Coconino NF boundary. Within the analysis area, there are 83.7 miles (22.7 percent) of potential perennial stream habitat, including Munds Canyon, Oak Creek, Pumphouse Wash, Rio de Flag, Sawmill Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek. Perennial streams on the Coconino NF within and adjacent to the project area are at high risk of increased sedimentation and ash flows resulting from stand-replacing crown fires. Ash flows produced from forest fires can negatively impact water quality. Stream morphology can be changed by sediment deposition. Alternative A would not mitigate these potential negative impacts. However, it is difficult to compare the known effects of the proposed action alternatives with the potential effects of hypothetical wildfire. Because there are no direct or indirect effects to macroinvertebrates or their habitat from alternative A, there can be no cumulative effects. Overall, forestwide riparian condition trend is mostly toward proper functioning condition, with some static areas (Steinke 2013). Overall trend in riparian acreage since 1987 is probably static to slightly upward with the addition of some riparian acreage in land exchanges (Steinke 2013). Macroinvertebrate population trends in high and low elevation streams on the forest are static. Alternative A **would not change macroinvertebrate habitat quality or quantity on the forest, nor would it change current forestwide trends**.	**Determination** There are 368.6 miles of potential macroinvertebrate habitat (perennial stream) within the Coconino NF boundary. Within the analysis area, there are 83.7 miles (22.7 percent) of potential perennial stream habitat, including Munds Canyon, Oak Creek, Pumphouse Wash, Rio de Flag, Sawmill Wash, Sterling Canyon, Sycamore Creek, and West Fork of Oak Creek. The soils report (Steinke 2013) indicates that prescribed fire treatments could result in soil erosion in areas where slope exceeds 15 percent. There would be a short-term risk (1–2 years) of sedimentation or ash flow resulting from these treatments. However, BMPs would be in place to mitigate these risks and proposed treatments would occur over a 10-year period, rather than all at once, so any impacts should be localized in extent. Alternative C proposes more acres of mechanical vegetation treatment than alternative B, but vegetation treatments should result in negligible soil erosion if BMPs are followed. Alternative D proposes far fewer acres of prescribed fire than either alternative B or C, but alternative D would not meet the purpose and need of the project. The short-term risks incurred by the proposed vegetation treatments and prescribed fire are necessary for the long-term benefit of the forest, including restoring the health of watersheds and streams in which macroinvertebrates live. Spring and stream restoration, as well as road decommissioning activities, could also result in short-term increases in soil movement and sedimentation. These proposed treatments are the same across all action alternatives. BMPs would be in place to mitigate these short-term risks in order to see long-term benefits from restored hydrologic function at spring sources, reduced potential for severe flooding in restored ephemeral channels, and reduced erosion and runoff resulting from properly decommissioned and/or relocated roads. Overall forestwide riparian condition trend is mostly toward proper functioning condition, with some static areas (Steinke 2013). The overall trend in riparian acreage since 1987 is probably static to slightly upward with the addition of some riparian acreage in land exchanges (Steinke 2013). Macroinvertebrate population trends in high and low elevation streams on the forest are static. Considering direct, indirect, and cumulative effects, alternatives B, C, and D **may impact individuals, but would not change macroinvertebrate habitat quality or quantity on the forest, nor would they change current forestwide trends.**

* The environmental consequences include a biological evaluation for the Southwestern Region Forest Service sensitive species

Noxious and Invasive Weeds

The noxious and invasive weed analysis is part of the botany specialist report which is incorporated by reference (Crisp 2013).

Noxious and invasive weed direction originated from a three-forest analysis (USDA 2005). The noxious weed FEIS/ROD was incorporated into the forest plans by amendment 20 to the Coconino forest plan and amendment 7 to the Kaibab forest plan. The species displayed in table 79 were evaluated for presence/absence in the treatment area. The species ranking is from the noxious weed FEIS and relates to the prioritization process that used various criteria including difficulty of control, successes with control efforts elsewhere, and life cycle (perennial vs. annual).

The options listed in table 79 in the objective column include prevention, eradication, and control. Prevention means minimizing introduction of a weed species into the project area and usually by combining with eradication to allow for elimination of spot populations as they arise. Eradication means attempting to totally eliminate a species from the forests. Control means preventing seed production throughout a target patch and reducing the area covered by a species, whereas contain means to prevent the species from expanding beyond the perimeter of existing patches.

Table 79. Treatment area noxious and invasive weeds evaluation

Species*	Common Name	Species Rank	Objective	Known to Occur in Treatment Areas (Y/N)
Euphorbia esula	leafy spurge	1	Eradicate	Y
Centaurea solstitialis	yellow starthistle	2	Eradicate	N
Centaurea melitensis	Malta starthistle	3	Eradicate	N*
Alhagi maurorum Syn. *Alhaghi pseudoalhagi*	camelthorn	4	Contain/Control	Y
Acroptilon repens	Russian knapweed	5	Contain/Control	Y
Cardaria draba	whitetop	6	Eradicate	Y
Salvia aethiopis	Mediterranean sage	7	Eradicate	Y
Carduus nutans	musk thistle	8	Eradicate	Y
Centaurea diffusa	diffuse knapweed	9	Contain/Control	Y
Centaurea stoebe ssp. Micranthos Syn. *Centaurea maculosa, Centaurea biebersteinii*	spotted knapweed	10	Eradicate	Y
Onopordum acanthium	Scotch thistle	11	Eradicate/Control	Y
Elaeagnus angustifolia	Russian olive	12	Contain/Control	N*
Tamarix spp.	tamarisk	13	Contain/Control	Y

Species*	Common Name	Species Rank	Objective	Known to Occur in Treatment Areas (Y/N)
Rubus procerus Syn. *R. armeniacus or R. discolor*	Himalayan blackberry	14	Contain/Control	N*
Cynoglossum officinale	houndstongue	15	Eradicate	N
Arundo donax	giant reed	16	Contain/Control	N*
Potentilla recta	sulfur cinquefoil	17	Prevent/Eradicate	N*
Linaria dalmatica	Dalmatian toadflax	18	Contain/Control	Y
Ailanthus altissima	tree of Heaven	19	Contain/Control	N*
Cirsium vulgare	bull thistle	20	Contain/Control	Y
Ulmus pumila	Siberian elm	21	Contain/Control	N*
Bromus tectorum	cheatgrass	22	Contain/Control specific populations	Y
Avena fatua	wild oats	23	Contain/Control	N*
Dipsacus fullonum	common teasel	24	Eradicate	N*
Chrysanthemum leucanthemum Syn *Leucanthemum vulgare*	oxeye daisy	Unassigned	Prevent/Eradicate	N
Cirsium arvense	Canada thistle	Unassigned	Prevent/Eradicate	N*
Halogeton glomeratus	halogeton	Unassigned	Prevent/Eradicate	N*
Isatis tinctoria	dyers woad	Unassigned	Prevent/Eradicate	N*
*Myriophyllum spicatum***	Eurasian water milfoil	Unassigned	**	N

N* = these species are not known to occur within treatment areas for the project, but are of concern due to their proximity and potential effects to restoration treatments. Partners have expressed concern for these species. Their rating system is explained below (Smith 2012).
** Unassigned.

In addition to the species identified for treatment in the forest plan, external partners expressed concern for other noxious or invasive weed species. Their rankings, goals for management, and rationale (discussed below) were incorporated into analysis and monitoring plan.

High Risk – these species currently have limited geographic distribution within the treatment areas. If current inventories indicate their presence within treatment areas, these species would be given priority and would be eradicated as soon as practicable. These species include leafy spurge, camelthorn, spotted knapweed, diffuse knapweed, Russian knapweed, white top, Mediterranean sage, Scotch thistle, tamarisk, and musk thistle.

Medium Risk – these species have widespread distribution within the treatment areas in large populations and include cheatgrass, Dalmatian toadflax, bull thistle, and wild oats. Areas would be prioritized for treatment based on risk to conservation value (presence or proximity of threatened, endangered, and sensitive species) and areas of high wildlife habitat value (e. g., pine-sagebrush ecotone).

Watch List – watch list species include Malta starthistle, Russian olive, yellow starthistle, Himalayan blackberry, giant reed, sulfur cinquefoil, tree of heaven, Siberian elm, halogeton, dyer's woad, Eurasian water-milfoil, oxeye daisy, Canada thistle, and common teasel. If these species are detected, aggressive eradication efforts would be a priority and addressed as soon as practicable.

Environmental Consequences

Alternative A

Direct, Indirect, and Cumulative Effects

There would be no direct effects. Weed infestations that might have been detected and treated would go unnoticed and continue to expand unless detected by other surveys or independent observations. The cumulative effects boundary is the Coconino and Kaibab NFs and the temporal timeframe is from 1995 to the present. Indirectly, increases in fire hazard and severity would increase the risk of noxious weed invasions in the project area. Warmer climate conditions may affect ecosystems by altering biotic and abiotic factors and increase the extent and severity of disturbances for some species (Bradley et al. 2010, Hellmann et al. 2008, Middleton 2006). Climate may favor the spread of invasive exotic grasses into arid lands where the native vegetation is too sparse to carry a fire. When these areas burn, they typically convert to nonnative monocultures and the native vegetation is lost (USDA 2010). Ongoing FS management actions combined with the Arizona Department of Transportation, Coconino County, and city of Flagstaff would continue to address and mitigate effects of noxious or invasive weeds and reduce the spread into new areas.

Alternatives B, C, and D

Direct and Indirect Effects

Direct effects include ground-disturbing activities that would have the potential to increase the acreage and/or density of the existing infestations within the project area. Management activities that would create localized severe disturbance include burned areas from slash piles, the creation of log decks, bare soil created through temporary road construction, road reconstruction (both road improvement and road relocation), decommissioning, stream channel restoration, and use by machinery during mechanical thinning. Broadcast burning and hand thinning would be sources of disturbance but the level of disturbance would not be as severe. Direct and indirect effects of temporary road construction, road reconstruction, road maintenance, or decommissioning include disturbance and increased risk of dispersal of existing weed species and populations and the introduction of new species. However, reducing the road mileage would help reduce the risk of present and future dispersal of noxious or invasive weeds along roadways (Rooney 2005). Spring and channel restoration would increase disturbance in the treated areas. With the incorporation of mitigation and best management practices (BMPs) (see appendix C of the DEIS), these effects would be reduced to nonsignificant levels.

Cumulative Effects

The cumulative effects boundary is the Coconino and Kaibab NFs within the project area boundary. This temporal timeframe includes management actions related to noxious or invasive weeds since 1995 to the present.

Beginning in 1995, the Coconino and Kaibab NFs began surveying and documenting noxious or invasive weed occurrences. Since 1997, noxious or invasive weed surveys were generally conducted on forest projects that would have management actions associated with soil disturbance. In 2005, the three-forest noxious weeds FEIS document and its provisions were incorporated into the Coconino NF and Kaibab NF by amendments 20 (Coconino NF) and 7 (Kaibab NF).This document represented a major change in the management of noxious or invasive weed control on the forests by allowing the use of herbicides on forest lands. All of the above actions were beneficial management actions that supported management control objectives for noxious or invasive weeds on the forest. These past actions have influenced the existing condition or baseline.

Forest Plan Amendments

The evaluation of how proposed plan amendments may affect noxious weeds is located in the "Plants" section of table 71, which describes alternatives B, C, and D sensitive species environmental consequences determination.

Heritage Resources

A summary of the heritage analysis is presented here, and the complete heritage specialist report (Gifford et al. 2013) is incorporated by reference.

The ponderosa pine ecosystem is the focus of the 4FRI forest restoration project. The area of potential effect (APE) is 988,930 acres. Within the project area, cultural resources range temporally from prehistoric times through the historic period and into the modern day. Prehistoric sites include rock art, cliff dwellings, pit houses, multiple room pueblos, artifact scatters, and traditional cultural properties. Historic resources consist of logging railroad grades, trails and historic roads, cabins and homesteads, Forest Service administrative sites, Basque sheep camps, mining camps, Civilian Conservation Corps remains, and Native American shelters such as sweat lodges and brush shelters.

Throughout the analysis area, archaeological site densities range from 1 to 66 sites per square mile (from the 4FRI heritage site density model—see Gifford 2011 for a full explanation of how the model was developed). Within the analysis area, there are 5,513 recorded archaeological sites with 123,716 acres on the Coconino NF and 214,485 acres on the Kaibab NF that have been previously surveyed for cultural resources. There are 15 sites on the Kaibab NF and 13 sites on the Coconino NF that are listed in the National Register of Historic Places (NRHP). There are 257 sites on the Kaibab NF and 1,007 sites on the Coconino NF that are eligible for the NRHP.

Cultural resources also include Native American traditional use areas and places known as traditional cultural properties (TCPs). These TCPs hold a central and important position in Native American culture. Three prominent examples found within the project area are the San Francisco Peaks on the Coconino National Forest and Red Butte and Bill Williams Mountain on the Kaibab

NF. See the tribal relations report and appendix A in the heritage report for more information on management of TCPs).

Heritage Strategy

The proposed activity in the 4FRI DEIS includes ground-disturbing activities such as mechanical thinning, hand thinning, stream restoration, temporary road construction, existing and temporary road closures, fencing, and prescribed fires. In consultation with the Arizona State Historic Preservation Officer (AZ SHPO), the Coconino and Kaibab forests developed a document called the “Four Forest Restoration Initiative Heritage Resources Strategy and NHPA Compliance” (Gifford 2011), otherwise referred to as the “heritage strategy.” There were three elements identified in the heritage strategy that would assist in reaching a no adverse effect determination for this project.

- The first is the focus on appendix J of the “Southwestern Region Heritage Programmatic Agreement.” Appendix J outlines the consultation protocols and strategies for implementing large-scale fuels reduction, vegetation treatment, and habitat improvement projects.
- The second component is the archaeological site density model created by the Coconino and Kaibab NFs. This model, created using existing site inventory data, identified high and low site density areas and assists in the design of survey strategies for specific project locations.
- The third aspect is the heritage strategy. Following appendix J, areas of intensive ground disturbances and areas of high site densities receive 100 percent survey. However, as per the strategy, areas of low site density can receive up to 25 percent of new or additional survey if existing surveys are not considered adequate. Sample survey needs are to be determined by heritage resources managers on a project-by-project or individual task order basis (see Gifford 2011 for details on the survey strategies).

Phased Section 106 Compliance

Because of the size of this undertaking, implementation would be phased over several years. Appendix J allows for the phasing of Section 106 compliance evaluations. Appendix J, the heritage strategy, and the initial 4FRI Section 106 report describe the methods to be used to achieve a no adverse effect determination for 4FRI as a whole.

Individual task orders or specific project areas would be evaluated by forest heritage staff for inventory needs and then surveyed to the appropriate level as defined in the heritage strategy. A Section 106 report would be produced for each project area as they are identified. Consultation with the AZ SHPO and tribes would be completed prior to implementing each task order.

Environmental Consequences

The environmental consequences for alternatives B, C, and D include applying the design features and mitigation measures displayed in appendix C of the DEIS.

Alternative A

Direct and Indirect Effects

Existing fuels in and around archaeological sites would continue to increase. This may result in more frequent and intense wildfires which could result in site and artifact damage such as spalling of rock art and cracking of artifacts as well as post-fire erosion. Fire suppression actions, particularly bulldozer operations, may also damage or destroy surface and subsurface archaeological sites resulting in the loss of those resources and their research potential. Additionally, sites are more visible after a fire, especially high-intensity fires, and much more vulnerable to vandalism.

Soil erosion due to uncharacteristic wildfires could have both a direct and indirect effect on cultural resources. Rain and snowmelt can cause channels to form within denuded sites, or mud slides from nearby slopes may deposit soil and debris within site boundaries leading to the loss of data potential and characteristics that make historic properties eligible for the National Register of Historic Places.

Environmental Consequences Common to Alternatives B, C, and D

Prior to initiating project-specific task orders, the forests would consult with federally recognized tribes to identify traditional use areas and, if necessary, develop project-specific mitigation measures to accommodate traditional use of the forest by tribal members.

Alternative B

Direct and Indirect Effects

Unnatural fuel loading should be reduced in and around National Register listed or eligible cultural resources. Uncharacteristic fire behavior should also be reduced. Thinning and low-intensity prescribed fires could reduce current fuel loads which would then assist in preventing extensive heat damage during wildfires. There would be less need for fire suppression activities, consequently reducing the threat of ground-disturbing activities like bulldozer fire line construction.

Mechanical thinning treatments, temporary road construction, and closures, skidding, and other ground-disturbing activities associated with 4FRI would have the potential to affect cultural resources. Impacts could include rutting, erosion, dislocation, or breakage of artifacts and features, and destruction of sites and site stratigraphy. Using prescribed fire also has the potential to affect fire sensitive sites. These potential effects would be addressed through site avoidance strategies and implementing the site protection measures listed in the “Southwestern Region Programmatic Agreement” (PA) (appendix J and in the heritage strategy).

Initial reduction of heavy fuels may lead to an increase in site visibility, public visitation, and possible vandalism. Those issues would be reduced through management actions that include project specific as well as long-term monitoring. Initial entry prescribed burns would be periodically revisited and burned to reduce natural fuel accumulation, and archaeological site monitoring would be part of that process. Possible road decommissioning could also assist in limiting access to some archaeological sites, thus reducing post-burn visibility and visitation at those sites.

There is the possibility that cultural resources would be discovered during project implementation. Discovery guidance is found in appendix J of the Southwestern Region PA.

See the “Tribal Relations” section and “Environmental Justice” section in the economics report regarding impacts to Native American traditional use areas and impacts from smoke on tribal communities.

Alternative C

Direct and Indirect Effects

This alternative includes a strategy for preserving an undisclosed numbers of large trees (large tree implementation plan) while meeting restoration objectives. It is more of a socio-political concern to contemporary culture rather than an impact to historic properties. Many of the ground-disturbing activities associated with this alternative would be similar to those identified in alternative B, and would have the same potential to affect cultural resources. Key components of this alternative include additional mechanical and prescribed fire on specific grasslands, and wildlife and watershed research and restoration. This alternative includes similar actions as alternative B, while having additional specific desired conditions for large trees and expanded grassland restoration as the primary differences.

One concern for heritage resources under this alternative is the increases in mechanical treatments. The 4FRI heritage survey strategy would address this concern. Per the strategy, intensive ground-disturbing activities would be inventoried for historic properties at 100 percent prior to implementation, thus identifying cultural resources prior to ground-disturbing actions. If additional high impact or intense mechanical treatments would be needed under this alternative, additional archaeological survey would be necessary per the heritage survey strategy. Potential effects to cultural resources would be avoided using the protection measures in the heritage protocol and Section 106 clearance report, or the adverse effects would be mitigated.

One potential benefit of this alternative would be the preservation of culturally modified trees. The 4FRI heritage survey strategy incorporates various levels of survey but not 100 percent across the entire project area. Since sample surveys do not identify all historic resources, leaving a larger number of 16-inch and above trees in place may preserve some of these unrecorded culturally modified trees. Conversely, one negative aspect of leaving large trees in place was noted during the bark beetle infestation on the Coconino NF. During that period, a number of larger ponderosa pines died in drier parts of the forest. Some of those trees had taken root in archaeological sites. When these dead trees fell, they uprooted portions of sites. Both of these examples are very limited in scale and would be minimized through implementing the 4FRI project. Landscape-level forest restoration could potentially decrease bark beetle impacts through a healthier forest and culturally modified trees on the Coconino and Kaibab NFs occur primarily in aspen stands, not ponderosa pine, the focus of this project. Therefore, any effects under the 4FRI would be very limited. Also see the “Tribal Relations” section and “Environmental Justice” section in the economics report for potential impacts to tribes.

Alternative D

Direct and Indirect Effects

Alternative D focuses on reducing prescribed fire in comparison to the proposed action (B). The alternative was developed in response to social concerns regarding smoke impacts in and around the area. Actions under alternative D are similar to those found in the proposed action (alternative B) with the principle difference being decreases in levels of prescribed fire and other options to remove thinning debris. Potential impacts to cultural resources would be similar to alternative B. The heritage strategy is flexible enough to respond to all of the various levels of implementation under alternatives B, C, and D.

Alternative D may benefit some fire sensitive cultural resources in areas of the forest with lower site densities. Per the heritage strategy, burn units with high site densities would be surveyed at 100 percent. In areas of low density, the heritage strategy option would be to survey an additional 25 percent if necessary. Current forest data, along with the 4FRI site density models and local heritage personnel's resource knowledge, would be used to identify and protect the majority of fire sensitive sites found in both high and low density areas. Nonetheless, there would always the possibility that small numbers of these fire sensitive sites could be affected and a reduction in prescribed fire may assist in preserving them.

A 30 percent reduction of prescribed fire would leave a significant amount of post-thinning debris and slash on the forests. Without prescribed fire, actions identified in the alternative such as chipping, shredding, mastication, and offsite removal of material would be required. Some of these activities may include ground-disturbing actions that could have an effect on cultural resources. Forest and district archaeological staff could address these effects by increasing the amount of archaeological survey within the area of these ground-disturbing activities and ensuring that cultural resources are avoided or the adverse effects are mitigated.

Consultation with Native Americans has indicated that some groups in surrounding communities have concerns regarding the amount of smoke that may result from project prescribed fire. The proposed reduction in burning under this alternative addresses those concerns. Also, see the "Tribal Relations" section and "Environmental Justice" information in the economics report for additional discussion about smoke impacts to tribal communities.

Forest Plan

For all alternatives, the potential impact to heritage resources from the proposed forest plan amendments is included in the "Tribal Relations" section.

Cumulative Effects

The spatial scale for cumulative effects is the area of potential effect (APE). Past, present, and foreseeable projects in appendix F of the DEIS were reviewed and used for the analysis.

Alternative A

Under the no action alternative, the proposed large-scale, landscape level forest health project would not occur, and there would be no additional effects as a result of this project. The present and foreseeable future undertakings would continue to have the potential to affect cultural resources. These undertakings will go through the Section 106 review process and all cultural resources that are listed on the National Register or eligible for the register would be avoided or the adverse effects would be mitigated. Any cumulative effects to cultural resources that could occur would not be considered to be adverse. High-intensity wildfires would threaten cultural resources because fuels will continue to accumulate and sites located within and near burn areas could be subjected to a potential increases in soil erosion.

Alternatives B, C, and D

Alternatives B, C, and D have the potential to increase the amount of ground-disturbing activities, including mechanical treatments, increased prescribed fire acres in alternative B, temporary road construction, skidding, stream restoration, fence construction, and other ground-disturbing activities. Alternative D may involve other means of slash and debris removal. Actions such as chipping, shredding, and mastication as well as removal of material offsite may include an increase in ground-disturbing actions. In alternatives B, C, and D, protection measures (as described the heritage strategy and Section 106 report) include the presence of archaeological monitors during mechanical activities, hand thinning within site boundaries, keeping ground-disturbing activities out of site boundaries by flagging and avoiding the sites, and post-prescribed fire site monitoring. These measures would be used to minimize the effects of low-intensity burns. Also, as noted for alternative A, all undertakings would go through the Section 106 review process and all cultural resources that are listed on the National Register or eligible for the National Register would be avoided or the adverse effects would be mitigated. The potential cumulative effects to cultural resources from increased ground-disturbing activities and prescribed fire resulting from these alternatives as well as the past, present, and forseeable future projects are, therefore, not considered to be adverse.

There would be a possibility for an increase in archaeological site vandalism resulting from increased visibility once the project is implemented. This visibility would be greater than that caused by past, present, or foreseeable future undertakings in the area. However, protection measures such as reducing vegetation on sites, or incorporating sites into wildlife bridge habitat locations, for example, would help to reduce the visibility of sites that were avoided during project implementation. In addition, the management practice of implementing low to moderate intensity prescribed fire typically does not sterilize soil or completely remove ground fuels like a high-intensity, uncontrolled wildfire. Low-intensity fires also tend to leave some trees in place that would eventually cover the surface with a recurring needle cast so artifacts will not be as visible. Sites are periodically monitored both during project implementation as well as for NHPA Section 110 purposes by Agency and volunteer personnel. Proposed road closures would reduce access to some of these areas as well, reducing the potential for increased vandalism. The cumulative effect of increased visibility is not considered to be adverse.

The cumulative effects on cultural resources resulting from any potential increase in erosion are also minimal. Reducing fuel loads and implementing low to moderate intensity prescribed fires would not cause soil sterilization or hydrophobic soils as high-intensity wildfires would. As noted previously, low-intensity prescribed fires leave some vegetation in place and revegetation occurs soon afterwards if soils are not sterilized. However, as implementation occurs, archaeologists would monitor for erosion concerns examining sites in the project areas, focused on slopes, drainages, and other high probability areas with cultural resources present. The cumulative effects to cultural resources caused by an increase in erosion are not considered to be adverse.

Overall, the cumulative effects on cultural resources as a result of alternatives B, C, and D are not considered to be adverse.

Tribal Relations

A summary of the tribal relations analysis, including the consultation process (table 80), is presented here. The complete specialist report (Johnson et al. 2013) is incorporated by reference.

The 4FRI project is situated across a landscape that is aboriginal to at least 16 American Indian tribes. Many of these tribal aboriginal lands overlap one another and areas of prominence which are considered sacred by tribes here in the southwestern United States. American Indian Law requires consultation between the U.S. Forest Service and federally recognized American Indian tribes; however, recognizing that we share a common interest to maintain the health of the forest, consultation extends beyond the legal requirements. With the knowledge that American Indian people have inhabited the 4FRI area for centuries, tribal consultation will consider traditional knowledge in order to restore and maintain a healthy forest ecosystem.

Consultation Process

The following tribes and tribal chapters who have historic ties and an interest in the Coconino and Kaibab National Forests were consulted with (table 80) and include: Kaibab Band of Paiute Indians, Navajo Nation including Coppermine, Coalmine, Naness, Lechee, Leupp, Bodaway, Cameron, Tuba City, Dilkon and Tolani Lake Chapters, Kaibab Band of Paiute Indians, San Juan Southern Paiute, White Mountain Apache, Yavapai-Apache Nation, San Carlos Apache, Hualapai, Yavapai-Prescott Indian Tribe, Havasupai, Tonto Apache, Pueblo of Zuni, Pueblo of Acoma, Hopi, and Fort McDowell Yavapai Nation.

Tribal consultation is primarily direct face-to-face meetings between federally recognized tribes and the Federal government. Consultation may include sharing of information through letter carried mail, email, and followup telephone calls which supplement the face-to-face meetings. Tribes that do not participate in tribal consultation continue to receive information via email and hand delivered mail. Information is shared unless a tribe asks specifically to not be informed. The tribal relations specialist report (project record) contains an up-to-date complete listing of information sharing and consultations with federally recognized tribes regarding the 4FRI. Tribal consultation will be ongoing throughout the entire span of the 4FRI project.

Contemporary Uses and Traditional Cultural Properties (TCPs)

Traditional Cultural Properties: American Indian resources may consist of shrines, trails and historic roads, and shelters such as sweat lodges and brush shelters. Traditional use areas and places are known as traditional cultural properties/places (TCPs). TCPs are places traditionally used by cultural groups over generations. TCPs within the project area include the San Francisco Peaks on the Coconino NF, and Red Butte and Bill Williams Mountain on the Kaibab NF. Natural springs are also considered TCPs and/or sacred sites by some tribes. Many plants are gathered for ceremonial use on or near TCPs. See appendix A of the heritage report for additional discussion on management of TCPs.

Table 80. Summary of 4FRI project tribal consultation

Date	Tribe(s)	Type of Contact	Location
September 10, 2009	Havasupai, Hopi, Hualapai, Kaibab Band of Paiute Indians, Pueblo of Zuni, Navajo Nation, and Yavapai-Prescott	The Kaibab NF supervisor sent an invitation to seven federally recognized tribes to discuss the 4FRI and other forest projects.	NA
September 28, 2009	Havasupai, Hopi, Hualapai, Kaibab Band of Paiute Indians, and Pueblo of Zuni	An initial presentation on the 4FRI was given during the Kaibab NF intertribal meeting.	Kaibab NF
May 5, 2010	Hopi, Pueblo of Zuni, Hualapai, Yavapai-Apache, Navajo Nation, and Yavapai-Prescott	The forest emailed information on the 4FRI as an early “heads up” on upcoming consultation.	NA
January 27, 2011	Hopi, Navajo Nation, Hualapai, Pueblo of Zuni, Pueblo of Acoma, Yavapai-Prescott, Yavapai-Apache, Ft. McDowell Yavapai, Tonto Apache, White Mountain Apache, San Carlos Apache, Havasupai, emailed to Hopi, Navajo Nation, Yavapai-Prescott, Ft. McDowell Yavapai, Hualapai, Havasupai, White Mt Apache, Yavapai-Apache, and Pueblo of Zuni	The forests mailed scoping letters to tribal leaders and emailed letter to representatives (also see chapter 1 of the DEIS).	NA
February 8, 2011	Havasupai, Hopi, Hualapai, Kaibab Band of Paiute Indians, Navajo Nation, Yavapai-Prescott Indian Tribe, and Pueblo of Zuni	The Kaibab NF supervisor sent a letter to seven federally recognized tribes with a copy of the SOPA and notification of the 4FRI project.	NA
May 12, 2011	Hopi, Navajo Nation, Hualapai, Pueblo of Zuni, Pueblo of Acoma, Yavapai-Prescott, Yavapai-Apache, Ft. McDowell Yavapai, Tonto Apache, White Mountain Apache, San Carlos Apache, Havasupai, emailed to Hopi, Navajo Nation, Yavapai-Prescott, Ft. McDowell Yavapai, Hualapai, Havasupai, White Mt Apache, Yavapai-Apache, and Pueblo of Zuni.	The forests sent the heritage report.	NA
August 22, 2011	Navajo Nation Kaibab Band of Paiute Indians, White Mountain Apache, Yavapai-Apache Nation, San Carlos Apache, Hualapai Tribe, Yavapai-Prescott Indian Tribe, Havasupai, Tonto Apache, Pueblo of Zuni, Pueblo of Acoma, Hopi Tribe, and Fort McDowell Yavapai Nation.	The second 4FRI scoping letter was sent to 20 tribal leaders (also see chapter 1 of the DEIS). No additional comments were received. See chapter 1 for a summary of concerns and issues raised throughout consultation.	NA
October 4, 2012	Havasupai	The Kaibab NF supervisor provided an update on the 4FRI project to the tribal council.	Supai, AZ

Contemporary Uses: The entire 4FRI project area is managed by the U.S. Forest Service and is aboriginal land to the consulting tribes. Along with aboriginal ties to the land, many tribal members also use the forest for traditional resources and ceremonies and for gathering medicinal plants for other traditional and cultural purposes. Traditional gatherings and ceremonies are conducted throughout the forests and may or may not occur at the knowledge of the land manager. Additionally these activities may occur over the span of an hour, to several hours or several days.

The forests recognize the importance of maintaining these traditions to area tribes and will accommodate traditional use of Forest Service lands by American Indians provided it complies with existing laws and regulations. In an attempt to reduce the likelihood of conflicts between traditional tribal activities and operations related to the 4FRI, consultation and coordination is a critical component between the tribes and forests regarding the timing and locations of specific planned activities and operations.

Years of government-to-government consultation have identified numerous traditional uses in or near the 4FRI project area. Examples of these uses include collection of forest products such as medicinal plants, tree boughs, ceremonial firewood, and pinyon nuts (see table 81), and ongoing use of ceremonial sites, shrines, and traditional gathering areas. Plant collecting is almost always conducted in more than one area in order to not deplete any particular plant species. In some cases, specific traditional use areas have been identified on the forests through project-level consultation. However, it is assumed most traditional use areas have not yet been identified. While some traditional uses consistently occur in one location, others may occur in a variety of locations based on the availability of resources.

Table 81. Example of forest products and their traditional use

Forest Product	Use
Juniper boughs	Shade structures
Small fir trees	Ceremony dances
Fir, pinyon, and juniper boughs	Ceremony dances
Cattails	Ceremony dances
Poles	Corrals, shades
Green oak up to 6″	Bows, Kiva ladder rungs
Ponderosa logs	Traditional ceremonial structures
Willow branches	Basketry
Yucca	Basket, soap

Threats to Contemporary Uses and TCPs

Wildfires are a threat to all forest products; however, fire suppression in the forest has also caused damage in the form of preventing the healthy production of juniper boughs, limiting the growth and production of small fir trees, and limiting the number of large ponderosa logs for ceremonial structures. Habitat for some native plants desired by tribal traditional collectors is disappearing and natural springs are drying up due to overstocked forests. Some of the affected plant collection areas and springs that were used historically still have associated cultural values that are important to the tribes. Concerns expressed by tribes during tribal consultation include:

- TCPs are at risk of being damaged or lost from high-severity fire;
- Springs and plant collection areas are at risk of being damaged or destroyed by high-severity fire;
- Overstocked stands are reducing the sunlight available for cultural and medicinal plants;
- Springs that are important to tribal ceremonies are drying up;
- A lack of low-intensity fire is reducing regeneration of plant collection areas;
- Smoke may affect some tribal communities;
- Tribes need access for ceremonies and traditional gathering; and
- Tribes are concerned about the preservation of cultural resources.

Environmental Consequences

The following mitigation (see appendix C in the DEIS for complete list) are common to alternatives B–D. The environmental consequences are based on applying these measures.

- Consult with Native Americans when projects and activities are planned in sites or areas of known religious or cultural significance (HR/TR-2);
- Project undertakings would be inventoried for cultural resources and areas of Native American religious use (HR/TR-3);
- Prior to initiating project-specific task orders, the forests would consult with federally recognized tribes to identify traditional use areas and, if necessary, develop project-specific mitigation measures to accommodate traditional use of the forest by tribal members (HR-TR-7);
- When areas are selected for treatment, detailed maps of the area would be presented to tribes through ongoing tribal consultation to determine if other sensitive areas of tribal importance could potentially be impacted (HR-TR-8); and
- Treatment timing would be adjusted to coincide with seasonal plant gathering and ceremonial use (HR-TR-9).

Alternative A

TCPs are at risk from high-severity fire because it can destroy the setting of the TCP including seed and habitat for native plants. Soil erosion due to high-severity wildfire could have a direct and indirect effect on traditional collecting areas. Rain and snowmelt could cause channels to form, or mud slides from nearby slopes could deposit soil and debris over traditional areas leading to the loss of biological communities for both plant and animal species used by tribes. This erosion could negatively impact areas where traditional use plants grow, thereby limiting opportunities for collection and traditional use. Additional indirect effects of erosion (as a result of wildfire) are damage to cultural resources when they are unearthed and displaced.

In this alternative, overstocked stands would continue to reduce the sunlight available for native cultural and medicinal plants. A lack of low-intensity fire would further reduce the regeneration of plants collected by native people. Over time, alternative A may result in the reduction of pre-settlement native plants, some of which have been collected since historical times by American Indians for food and medicine. Additionally, as tree density (overstocking) increases, historic water sources such as springs and seeps (that are important locations to American Indians) may dry up, affecting historic uses.

With continued drying trends across the Southwest, the forests would likely issue forest closures and fire restrictions, thus affecting traditional uses and ceremonies. Access could be limited during active fire suppression activities.

Alternative B

Alternative B proposes restoration treatments that would result in reduced fuel loading and a more open forest structure and pattern. Mechanical and prescribed fire treatments would reduce the potential for uncharacteristically intense fire behavior. This would reduce the potential for severe impacts to National Register listed or National Register eligible heritage resources (which are known to be of interest to the tribes representing the "footprints of their ancestors"). Mechanical treatment and low-intensity prescribed fires would reduce current fuel loads which would help to prevent extensive heat damage to traditional collection and gathering areas from future wildfires. There would be less need for fire suppression activities, consequently less of a threat from ground-disturbing activities like bulldozer fire line construction in sensitive areas.

Mechanical thinning treatments, temporary road construction, decommissioning, and other ground-disturbing activities associated with the 4FRI have potential to affect traditional collecting and gathering, ceremonial areas, and TCPs by temporarily displacing collecting gathering and ceremonial activities. Impacts would not be as disruptive as those periods of wildfire suppression. Access concerns would be addressed through ongoing consultations between the forests and American Indian groups. In addition, mitigation was developed to minimize disruption of activities and includes adjusting treatment timing to coincide with seasonal plant gathering and ceremonial use.

Using prescribed fire also has the potential to affect fire sensitive areas. However, as early as the first growing season after the initial reduction of heavy fuels, an increase in understory plant growth would be expected. Mechanical treatments may provide better habitat for these plants to thrive. Fire and ground disturbance can also enhance certain plant species such as wild tobacco. Overall, treatments could provide a prolific diversification of certain plant species. Local tribal people could potentially have greater access to collecting areas as existing roads are improved. The demand for groundwater that is currently occurring from dense tree growth would be reduced. Treatments may promote an increase in water flowing from springs and possibly restore springs that have dried up. Activities proposed in alternative B would result in greater opportunity for contemporary tribal uses such as native plant collection and enhancement of TCPs such as springs.

All action alternatives (B–D) create the potential for increased smoke. Most of the smoke from fire use on the Coconino and Kaibab NFs would carry from the southwest to the northeast and to the Havasupai Reservation and western portions of the Navajo Nation Reservation. Many people living in these areas are seniors with health conditions and sensitivity to smoke. The effects of limited communications may hinder receiving adequate information about smoke. Some may not have access to an Internet Web site to receive information on planned prescribed fires. In addition, there may be language barriers and cultural differences. Tribal consultation would continue throughout project implementation and will strive to inform tribes on the timing, type, and amount of smoke tribes may experience during implementation. See the complete environmental justice analysis in the economics report.

Alternative C

Many of the ground-disturbing activities associated with this alternative are similar to those identified in alternative B, and have the same potential to affect traditional collecting and gathering, ceremonial areas, and TCPs. Key components of this alternative include additional acres of mechanical and prescribed fire on specific grasslands, wildlife and watershed research, and inclusion of the large tree implementation plan.

One concern for traditional collecting and gathering, ceremonial areas, and TCPs under this alternative is the increase in mechanical treatment acres. If additional high impact or intense mechanical treatments occur under this alternative, additional tribal consultation would be necessary. Protection of cultural resources are discussed in the "Heritage" section (see the "Heritage" section and appendix C of the DEIS for additional information).

Alternative D

Alternative D would reduce the use of prescribed fire across the project area in comparison to the proposed action (alternative B). This would reduce the potential for smoke to impact tribal communities. Potential impacts to traditional collecting and gathering, and ceremonial areas and TCPs are the same as described in alternative B.

Forest Plan Amendments – All Alternatives

Amendment Theme—Management in MSO Habitat: The amendments that address management in MSO owl habitat (see appendix B) would be primarily related to the definition of target and threshold habitat, the size and amount of trees to be cut, prescribed fire and MSO monitoring. There would be no discernible effects to heritage resources or tribal relations from defining target and threshold habitat or MSO owl monitoring. Applying prescribed fire and the size and amount of trees to be cut within MSO habitats would have the same direct, indirect, and cumulative effects as described for each action alternative.

Amendment Theme—Management of Canopy Cover and Ponderosa Pine with an Open Reference Condition Within Goshawk Habitat: These amendments (see appendix B) would provide desired percentage of interspaces, distance between tree groups, clarification of where cover is measured, add definitions, and acreage to be managed in an open condition. There would be no discernible effects to heritage resources or tribal relations from these amendments. The direct, indirect, and cumulative effects would be the same as described for each action alternative.

Amendment Theme—Effect Determination for Cultural Resources on the Coconino NF: This amendment (see appendix B) would delete the standard that would require achieving a "no effect" determination and adds the words "or no adverse effect" to the remaining standard. Currently management actions on the Coconino NF strive to achieve a "no effect" for cultural resources; however, during implementation of this project it would be extremely unlikely to ever achieve a “no effect” on cultural resources. Though surveys and monitoring of heritage resources would occur and BMPs would be implemented, there would be a chance that heritage resources would be impacted (see “Heritage Resources” section). There would be no additional discernible effects to heritage resources or tribal relations from this amendment. The direct, indirect, and cumulative effects would be the same as described for each action alternative.

Amendment Theme—Management of the Proposed Garland Prairie RNA on the Kaibab NF: This amendment (see appendix B) would add language to allow prescribed fire and mechanical treatments in order to maintain and/or restore the ecological qualities of the proposed RNA. There would be no additional discernible effects to heritage resources and tribal relations from this amendment. The direct, indirect, and cumulative effects would be the same as described in the action alternatives.

Cumulative Effects – All Alternatives

In **alternative A** there would be no changes in current management and the forest plans would continue to be implemented. Approximately 82,592 acres of vegetation treatments and 96,125 acres of prescribed fire projects would continue to be implemented adjacent to the treatment area. Within the next 5 years, approximately 86,771 acres of vegetation treatments and 142,869 acres of prescribed fire and maintenance burning would be implemented adjacent to the treatment area by the Forest Service. The Kaibab and Coconino NFs have tribal relations specialists who would continue to consult with tribes on the preservation of cultural resources, implementation of project activities, and appropriate post-treatment monitoring for these projects.

Over the majority of acres described above, current fuel loads would be expected to decrease over time as projects are implemented. This would result in decreased wildfire severity and erosion potential. However, traditional use plants, TCPs, and traditional use areas do not occur evenly across the area nor do the projects propose to treat those areas equally. Therefore, the cumulative impacts under this alternative are limited or unknown. Other prominent landmarks identified as TCPs (including springs) in the project area would be left untreated and could be severely impacted if a wildfire burned through these areas. If not treated, springs would likely continue to dry up or have the potential to be polluted by excessive runoff by flash flooding as a result of rain on burned slopes.

Alternative B has the potential to increase the amount of ground-disturbing activities, including mechanical treatments, temporary road construction, skidding, stream restoration, fence construction, and other ground-disturbing activities. When considered together with past, present, and foreseeable future actions, these activities would have the potential to affect cultural resources such as traditional collecting, gathering, ceremonial use areas, and TCPs. All undertakings that would have the potential to affect cultural resources would go through tribal consultation. In addition, protection measures such as the possibility of tribal monitors during mechanical activities, keeping ground-disturbing activities out of sensitive areas by flagging, avoiding the sensitive areas, and post-prescribed fire monitoring to assess the effects of the low-intensity fires would help to minimize the effects. The potential cumulative effects to cultural resources and TCPs such as springs from increased ground-disturbing activities and the use of prescribed fire resulting from this alternative are, therefore, not considered to be adverse. The cumulative effect of increased visibility is not considered to be adverse.

The cumulative effects on TCPs, gathering, and ceremonial areas resulting from any potential increase in erosion would also be minimal. Reducing fuel loads and implementing low to moderate intensity prescribed fires would not cause soil sterilization or hydrophobic soils as high-intensity wildfires do. Low intensity prescribed fires would leave some vegetation in place and revegetation would occur soon afterwards if soils were not sterilized. However, as implementation occurs, monitors would check for erosion concerns by examining culturally sensitive locations like TCPs and ceremonial sites in the project areas, including focusing on slopes, drainages, and other high probability areas with cultural resources present. The cumulative effects to cultural resources caused by an increase in erosion are not considered to be adverse.

In **alternative C,** the addition of the LRTP would have little additional effect on cultural resources, TCPs, ceremonial areas, and gathering and collecting areas. However, an increase in prescribed fire acres, as well as similar actions identified under alternative B—such as mechanical treatments, prescribed fire, stream restoration, and fence construction—would have the potential to affect these resources. These issues are identified under the cumulative effects section under alternative B and not repeated here. As noted previously, all undertakings that have the potential to affect cultural resources would go through tribal consultation. An increase in these types of activities would not result in an adverse effect to cultural resources as long as tribal consultation is conducted prior to project implementation, protection measures are imposed, and post-project implementation monitoring is conducted when appropriate.

As with alternatives B and C, similar increases in activities under **alternative D** such as mechanical treatments and ground disturbances can add to the effects on cultural resources. Additionally, specific to this alternative, is a reduction in the prescribed fire acres which may involve other means of slash and debris removal. Actions such as chipping, shredding, and mastication as well as removal of material offsite may include an increase in ground-disturbing actions. As noted above, all undertakings that have the potential to affect cultural resources would not have an adverse effect if the measures identified above are implemented. Protection of cultural resources measures are discussed in the “Heritage” section (see “Heritage” section in chapter 3 and appendix C of the DEIS). Overall, the cumulative effects on cultural resources as a result of alternative D are not considered to be adverse.

Socioeconomics

A summary of the socioeconomic report is presented here. The specialist report (Jaworski 2013) is incorporated by reference. The analysis describes the current conditions and trends related to the social and economic environment of the planning area, including: population and demographic changes, potential environmental justice populations, and employment and income conditions. Economic impacts were modeled using IMPLAN Professional Version 3.0 with 2010 data. Economic efficiency analysis was conducted with QuickSilver Version 6. Social impacts use the baseline social conditions presented in the “Affected Environment” section, National Visitor Use Monitoring (NVUM) profiles (USDA 2011a and USDA 2011b), and information from the Coconino and Kaibab economic and social sustainability assessments (USDA 2010, 2008) to discern the primary values that the forests provide to area residents and visitors.

Affected Environment

Communities in the vicinity of proposed treatments include Flagstaff, Munds Park, Mormon Lake, Tusayan, and Williams, Arizona. Much of the related processing of the 4FRI forest products is expected to occur in Winslow, Arizona.

These communities are heavily influenced by their proximity to protected public lands, particularly Grand Canyon National Park. Tourism is a major economic driver, particularly in Tusayan and Williams. The economies are increasingly dependent on management, education, and tourism sectors, while consumptive natural resource industries have declined. Over the past 20 years, the population in the study area has grown substantially, indicating that the area offers both economic opportunity and natural amenities.

Population

The study area is home to 4,270,020 people (U.S. Census Bureau 2010). Table 82 displays population data for the counties, State, and nation in 1990, 2000, and 2010. Maricopa County is by far the largest county in the study area. Maricopa County alone accounts for approximately 60 percent of Arizona’s population. All counties within the study area are fast growing (over 10 percent population growth in a 10-year period). Population growth in Yavapai and Maricopa Counties was similar from 1990 to 2010, growing approximately twice as fast as Navajo and Coconino Counties. While Maricopa County’s growth is driven by economic diversity and activity, Yavapai, Coconino and Navajo Counties’ growth is more amenity-based because of the easy access to open space and Federal lands. Slower growth in Navajo and Coconino Counties reflect their lower population density and corresponding lower levels of public services like health care and transportation. In Yavapai County, both the population density and median age are much higher than Navajo and Coconino Counties, reflecting the influence of retirees on the county’s population growth.

Table 82. Population change 1990 to 2010

Geographic Area	1990 Population	2000 Population	Percent Growth 1990–2000	2010 Population	Percent Growth 2000–2010
Coconino County	96,591	116,320	20.4%	134,421	15.6%
Maricopa County	2,122,101	3,072,149	44.8%	3,817,117	24.2%
Navajo County	77,658	97,470	25.5%	107,449	10.2%
Yavapai County	107,714	167,517	55.5%	211,033	26.0%
Arizona	3,665,228	5,130,632	40.0%	6,392,017	24.6%
United States	248,709,873	281,421,906	13.2%	308,745,538	9.7%

Source: U.S. Census Bureau 2010

Economic Diversity, Employment, and Income

Per capita income in the study area is similar to per capita income in the State and nation. Navajo and Coconino Counties have lower per capita income than the other study area counties, the State, and the nation (table 83). This is consistent with the finding in the “Environmental Justice” section that Navajo and Coconino Counties have higher poverty rates relative to the study area, the State, and the nation. A greater proportion of personal income in Navajo County is made up of nonlabor income (such as transfer payments), which indicates that low-income assistance programs may be a greater portion of household income. Yavapai County has a slightly higher rate of nonlabor income but given the demographics of this county and its higher per capita income, these payments are more likely to consist of earned interest and social security payments to retirees. Another indicator that poverty is the greatest concern in Navajo County is that its unemployment rate has consistently been 30 to 50 percent higher than the other counties in the study area.

Table 83. Per capita income, labor, and nonlabor income, and unemployment

Geographic Area	Per Capita Income (2010 Dollars)	Labor (2009)	Nonlabor (2009)	Unemployment (2010)
Coconino County	19,703	62%	38%	8.9%
Maricopa County	25,350	66%	34%	9.1%
Navajo County	16,745	47%	53%	15.7%
Yavapai County	22,619	43%	57%	10.5%
Arizona	23,618	62%	38%	10.0%
United States	26,059	64%	36%	9.6%

Source: U.S. Census Bureau 2010, table DP03

Maricopa County has the most diverse economy in the study area, with only retail trade and government sectors accounting for more than 10 percent of employment. The other counties in the study area have lower economic diversity with some distinctive differences in sectors of employment. Yavapai County, as would be expected of a retirement community, has the largest percentage of its employment in health and social services compared to the rest of the study area. This diversity reflects the demographics driving the local economy. By contrast, Coconino County, which has a larger tourism base to its economy, has the highest percentage of accommodations and food services and arts, entertainment, and recreation within the study area. Navajo County has a smaller percentage of employment in service industries that would support tourism or retirement age in-migration, but has the highest employment rates in government and consumptive natural resource sectors (agriculture, forestry, fishing and hunting, and mining). Wage differences and higher unemployment may also be tied to these factors. Within Navajo County, poverty, unemployment, and income appear to be unevenly distributed geographically. Most employment centers are south of I-40 in Winslow and other more centralized communities. North of I-40, the county is dominated by three Indian reservations (see figure 46 for race and ethnicity information) where there are fewer employment opportunities, lower population density, and less opportunity for amenity-based population and economic growth as seen in parts of Coconino and Yavapai Counties.

Wildfire and Forestry Related Economic Environment

Table 84 shows the economic contribution of forestry related sectors to the local economy. In terms of employment, forestry related sectors account for approximately one-third of 1 percent of study area employment. This is less than the Statewide contribution, where forestry related jobs account for approximately 0.63 percent of total employment. The same trend is observed in employee compensation and output—the forestry sector in the study area is relatively smaller than in other parts of the State. However, the economic contribution of forestry related sectors in

Navajo County is proportionally greater than the economic contribution of forestry related sectors in the other study area counties and the State. In addition, a new wood products plant is planned for the Winslow area which would further increase forestry related employment in Navajo County. These findings indicate that the study area is currently less specialized in forestry than the rest of the State, except for Navajo County.

Table 84. Economic contribution of forestry related sectors in the study area

Geographic Area	Employment		Employee Compensation (in USD Millions)		Output (in USD Millions)	
	Value	Percent of Total	Value	Percent of Total	Value	Percent of Total
Coconino County	182	0.25	4	0.13	15	0.19
Maricopa County	6,784	0.31	192	0.20	801	0.26
Navajo County	683	2.04	33	2.49	245	6.56
Yavapai County	154	0.22	5	0.22	12	0.16
Study Area Total	7,803	0.33	221	0.22	955	0.29
Arizona	20,169	0.63	575	0.42	1,713	1.26

Source: MIG 2009

Annually, millions of dollars are spent suppressing wildfires in the United States. In 2007, there were 27 large fires in the U.S. that cost $547 million to suppress (WFLC 2010). Between 2000 and 2008, the percentage of the Forest Service budget spent on extinguishing wildfires expanded from 25 to 44 percent (WFLC 2010). Furthermore, suppression costs account for only a fraction of the total cost of wildfires. The Western Forestry Leadership Coalition (WFLC) estimates that total wildfire related expenses range from 2 to 30 times the reported suppression costs (2010).

A principal reason for the increasing cost is the growing number of homes located in the wildland-urban interface. Suppression activities are frequently undertaken when wildfire threatens private property. A century of fire suppression has led to increased fuels and, therefore, frequency of high-intensity wildfire. The spread of the WUI has increased the probability that wildfires will occur near private residences. These two factors—the growth of the WUI and the use of suppression tactics—increase the cost of wildfire and the importance of forestry treatments to reduce fuels that have increased high-intensity fires. Table 85 presents the extent of the WUI in the study area counties and the western United States.

One-quarter of Coconino County homes, nearly 20 percent of Navajo County homes, and approximately 10 percent of Yavapai County homes are located within the WUI. Both Coconino and Yavapai Counties are also in the top quintile for existing fire risk. These factors make it more likely the Coconino and Yavapai Counties will experience large, expensive wildfires.

Table 85. Wildland-urban interface, planning area, and westwide (2000)

Geographic Area	WUI Area with Homes	WUI Homes as Percent of Total Homes	Westwide Rank by Existing Wildfire Risk
Coconino County	21.5%	25.6	55 of 413
Navajo County	26.5%	18.7	93 of 413
Maricopa County	16.9%	0.3	161 of 413
Yavapai County	23.5%	9.7	71 of 413
Western U.S.	13.9%	3.9	NA

Source: Guide et al. 2008

Nonmarket Values

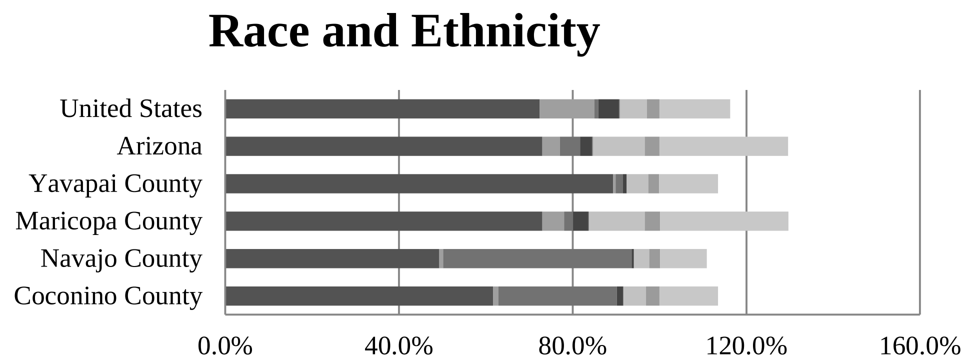
The economic value of Forest Service management is not entirely captured in market transactions. Much of the value of national forests is “nonmarket” in nature—meaning that many of the benefits that forests provide to humans do not have a price. The lack of a price, however, should not be equated with an absence of value. Indeed, nonmarket values from forests provide economic benefits to adjacent communities and forest visitors. Healthy forests provide numerous ecosystem services, including clean water and air, biodiversity, forest products, and many other goods and services.

Where appropriate, discussion of how the alternatives may affect nonmarket values is presented. However, due to the qualitative nature of these discussions, direct comparisons between changes in market and nonmarket values are generally not possible.

Environmental Justice

In 1994, President Clinton issued Executive Order (EO) 12898. This order directs Federal agencies to focus attention on the human health and environmental conditions in minority and low-income communities. The purpose of EO 12898 is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations.

The emphasis of environmental justice is on health effects and/or the benefits of a healthy environment. The CEQ has interpreted health effects with a broad definition: “Such effects may include ecological, cultural, human health, economic or social impacts on minority communities, low-income communities, or Indian Tribes …when those impacts are interrelated to impacts on the natural or physical environment” (CEQ 1997). According to the U.S. Census Bureau (2010) data reported in figure 46, study area counties differ substantially in their racial and ethnic composition.



	Coconino County	Navajo County	Maricopa County	Yavapai County	Arizona	United States
White	61.7%	49.3%	73.0%	89.3%	73.0%	72.4%
Black or African American	1.2%	0.9%	5.0%	0.6%	4.1%	12.6%
American Indian and Alaska Native	27.3%	43.4%	2.1%	1.7%	4.6%	0.9%
Asian	1.4%	0.5%	3.5%	0.8%	2.8%	4.8%
Native Hawaiian and Other Pacific Islander	0.1%	0.1%	0.2%	0.1%	0.2%	0.2%
Some Other Race	5.2%	3.4%	12.8%	4.9%	11.9%	6.2%
Two or More Races	3.1%	2.5%	3.5%	2.5%	3.4%	2.9%
Hispanic or Latino (of any race)	13.5%	10.8%	29.6%	13.6%	29.6%	16.3%

Figure 46. Race and ethnicity

Source: U.S. Census Bureau 2010, table DP-1

Coconino and Navajo Counties have high concentrations of American Indian residents, due to the presence of five reservations in Coconino County and three reservations in Navajo County. Maricopa and Yavapai Counties also contain Indian reservations; however, their concentrations of American Indian residents are small relative to Coconino County, Navajo County, and Arizona.[11] Maricopa County has the highest proportion of Hispanic/Latino residents in the study area, although it is equivalent to Arizona's proportion (29.6 percent). In contrast, Yavapai County is less diverse than both the State and nation. Approximately 90 percent of Yavapai County residents self-identify as white. As a result, environmental justice issues are more likely to occur in Coconino and Maricopa Counties than Yavapai County. However, a finding of low racial/ethnic diversity does not eliminate the need to consider potential disproportionate impacts of Forest Service management actions. A county may have a low overall concentration of minority

[11] Coconino County contains all or part of the Navajo Indian Reservation, Hualapai Indian Reservation, Hopi Indian Reservation, Havasupai Indian Reservation, and Kaibab Indian Reservation. Navajo County contains part of the Navajo Indian Reservation, Hopi Indian Reservation, and Fort Apache Indian Reservation. Maricopa County contains all or part of the Fort McDowell Yavapai Nation, the Gila River Indian Community, and the Salt River-Pima Indian Community. Yavapai County contains all or part of the Yavapai-Prescott Indian Reservation, the Yavapai-Apache Nation Indian Reservation, the Hualapai Indian Reservation, and the Camp Verde Indian Reservation.

residents, but still have areas with a high concentration of minority residents who could be adversely affected by management actions.

The incidence of poverty in Coconino and Navajo Counties is not evenly distributed among racial and ethnic groups. Approximately 50 percent of American Indian residents in Coconino County and 70 percent of American Indian residents in Navajo County live in poverty (U.S. Census Bureau 2000). The high proportion of American Indian residents in these counties, therefore, increases the poverty rate relative to other study area counties and the State.

Based on the minority status and poverty data (see specialist report), Coconino County appears most at risk for environmental justice issues. The largest minority group in the county, American Indians, also experience a very high poverty rate. Furthermore, Coconino County contains the most acreage that could be affected by the first stage of the 4FRI, which suggests that the consequences of management actions would be felt most acutely by Coconino County residents. In contrast, although Navajo County also has a high proportion of American Indian residents and a high poverty rate, the first stage of the 4FRI treatments would not occur in the county. Navajo County would be chiefly affected by employment associated with the proposed plant in Winslow.

In response to a comment from the June 2012 NEPA update public meeting, the possibility of smoke related environmental justice consequences in Snowflake, Arizona, were evaluated. The community does not have a meaningfully greater percentage of minority residents than the State, and Snowflake has a smaller proportion of individuals living in poverty than either the State or nation (U.S. Census Bureau 2010). In addition, the community is geographically distant from the project area and, therefore, unlikely to experience acute smoke effects. As a result, Snowflake is not considered an environmental justice community in this analysis.

The air quality analysis finds that Flagstaff, Williams, Verde Valley, and Grand Canyon National Park are smoke sensitive areas within proximity to the proposed treatments. The communities of Camp Verde, Cornville, Cottonwood, and Flagstaff are expected to be affected by the proposed prescribed fire treatments. Camp Verde, Cornville, Cottonwood, and Flagstaff all have lower concentrations of minority residents and lower poverty rates than the study area as a whole (U.S. Census Bureau 2000). Therefore, the potentially disproportionate effect of smoke emissions on these communities is not an environmental justice issue. However, the implications of smoke emissions on the 4FRI area communities, particularly vulnerable communities, are addressed in both the air quality and social analyses.

Numerous tribal communities are in airsheds that may be affected by the 4FRI prescribed fires. The potential for disproportionate smoke emissions effects to tribal communities is addressed in the environmental consequences analysis. Effects to tribal uses are addressed in the tribal relations report.

Environmental Consequences

Alternative A – Direct and Indirect Effects

No changes to visitor spending or recreational activities are anticipated under alternative A. Visitors to the Kaibab and Coconino NFs would continue to contribute approximately 3,000 jobs and $110 million in labor income to the study area economy on an average annual basis.

Forest restoration activities would continue to occur on both forests with possible minor interruption of recreational opportunities. Over the long term, fewer treated forest acres would increase the probability of uncharacteristic wildfire under alternative A. Large wildfires destroy trails, campsites, and other forest infrastructure. Major and destructive fires decrease tourism to the local area, which would reduce recreation related employment and income in the regional economy.

The forests would continue to provide forage for 110,173 cattle animal unit months (AUMs) and 13,616 sheep AUMs. These activities support approximately 130 jobs and $2.15 million in labor income to the study area economy on an average annual basis. The increased probability of uncharacteristic wildfire on untreated land could lead to the destruction of pasture, reduce forage availability, and lead to soil erosion. These conditions could reduce available AUMs. Therefore, over the long term, untreated land could lead to a reduction in grazing related employment and income.

Under alternative A, both forests would continue to provide forest products and support restoration activities. However, the scale of these activities would be substantially smaller than activities under this project. The provision of forest products unrelated to the 4FRI treatments would be the same under all alternatives and, therefore, are not described in detail in this report. Much of the harvesting and processing of forest products would occur in Winslow (Navajo County). Employees are expected to come from both Navajo County and surrounding counties. The proximity of Winslow to Coconino County suggests that cross-county commuting is particularly likely between Navajo and Coconino Counties.

Historically, the Coconino and Kaibab NFs have annually spent an average of $7,154,801 and $4,456,770 on wildfire, respectively. Under alternative A, wildfire suppression costs would, on average, increase due to fuel buildup and the expanding wildland-urban interface. The per acre administrative burden (cost of time and other resources) of planning, implementation, and monitoring forest restoration activities would be highest under alternative A. The 4FRI benefits from economies of scale —a single environmental compliance document addresses nearly 600,000 acres of restoration activities. Furthermore, the large treatment area reduces cost to government through increased private sector interest in engaging in harvesting and restoration activities on the forests. In contrast, restoration activities under alternative A would occur piecemeal, requiring numerous environmental compliance documents and increased administrative costs.

The cost to the government to treat an area equivalent to the 4FRI project area would be approximately $12 million annually. Discounted at 4 percent over a 10-year period, this is equivalent to a cost of more than $100 million. In contrast, the certainty of a sustained supply under the 4FRI would encourage private sector restoration, significantly reducing costs to government.

Alternative A would not produce measurable social consequences relative to the existing condition. Quality of life and social values would not be affected. As with current conditions, wildfire could displace recreational activities, compromise forest scenery, and degrade air quality. Uncharacteristic wildfire conditions would reduce the quality of life of area residents and forest visitors.

The communities that surround the 4FRI project area, particularly in Coconino and Navajo Counties, have large minority populations, a relatively high population, and individuals vulnerable to smoke. None of the alternatives eliminates smoke, either from wildfire or prescribed fire. Alternative A would treat the fewest acres with prescribed fire. However, it would also do the least to restore fire-adapted forests. As a result, smoke from uncharacteristic wildfire is most likely under this alternative.

Cumulative Effects

Forest restoration activities are emphasized in the existing and proposed forest plans in the region. Restoration activities would continue to occur in the region regardless of the 4FRI decision. Between 2001 and 2010, approximately 132,495 acres have been treated on the Coconino and Kaibab NFs. Ongoing and reasonably foreseeable projects will treat an additional 110,940 acres. These actions will occur regardless of the 4FRI selected alternative. Since 2000, approximately 80,000 acres (78,734) have been treated on private, State, and other federally managed lands in the project area. The effect of past, present, and reasonably foreseeable treatment activities in the project area would improve forest health relative to existing conditions even without implementation of the 4FRI.

Environmental Consequences Common to Alternatives B, C, and D

Table 86 displays the change in employment and income between current conditions and the action alternatives. The changes in employment and income under alternatives B, C, and D reflect a temporary reduction in recreation related employment and income due to recreation displacement and an increase in employment and income due to the 4FRI harvesting and processing activities.

Table 86. Change in employment and labor income from alternative A

Measure	Alt. B	Alt. C	Alt. D
Change in Employment	1,615	1,615	1,615
Change in Labor Income	$75.6 million	$75.6 million	$75.6 million

Table 87 summarizes the net present value of the 4FRI treatments. Over the 10-year treatment period, assuming a 4 percent discount rate, the 4FRI would be expected to produce a $100 million benefit. This would be the discounted cost savings to the government of the 4FRI relative to the average cost per acre that the government pays for restoration treatment. This figure can be viewed as a proxy for the economic value of the 4FRI treatments.

Table 87. Net present value of stewardship contracts

Measure	Alt. B	Alt. C	Alt. D
Net Present Value of Stewardship Contracts	$100 million	$100 million	$100 million

Alternatives B, C, and D would provide approximately 360,000 CCF of timber and 8,000 dry tons of biomass on an average annual basis throughout the 10-year treatment period. Harvesting and utilization activities related to the 4FRI would support approximately 1,674 jobs and $77.6 million in labor income in the study area economy on an average annual basis throughout the 10-year project period. The proposed plant in Winslow, Arizona (Navajo County), would account for much of the expected employment. Forest Service project administration would require 35 employees who are currently on staff.

Approximately 2 percent of the Coconino and Kaibab NFs would be unsuitable for recreational uses at any given time due to the 4FRI restoration activities. As section 4.6 of the NVUM surveys for the forests demonstrate, when individuals are unable to visit their preferred site, most would engage in substitute behavior that would continue to have an effect in the local economy (USDA 2011a, USDA 2011b). As a result, the 4FRI treatments would not be expected to measurably reduce the economic impact of recreation in the study area. However, if recreational activities were reduced one-to-one with the reduction in suitable recreation areas (i.e., by 2 percent), approximately 2,940 jobs and $108 million in labor income would be supported on an average annual basis for the duration of the project. This would be a decrease of approximately 60 jobs and $2 million in labor income relative to alternative A. This possible decrease in employment and income is reflected in table 86.

The 4FRI treatments would entail one major pasture burn per year per allotment. Over the 10-year treatment period, a 10 percent reduction in AUMs is expected. At the end of the 10 years, a return to pre-treatment AUM levels would occur. Therefore, during the 10-year treatment period, cattle AUMs would decrease to approximately 100,000 and sheep AUMs would decrease to approximately 12,250. At current levels, grazing supports approximately 130 jobs and $2.15 million in labor income in the local economy, annually. The brief duration and advance notice of disturbances due to the 4FRI treatments would make it easier for ranchers to adapt to changes. As a result, no reductions in grazing related employment would be expected. However, minor reductions in rancher income would be possible if ranchers purchased more expensive private forage or reduced their stocking levels. However, post-treatment soil and forage quality would be expected to increase. Therefore, over the long term, ranchers would benefit from the 4FRI activities.

Some individuals may not be able to recreate at their preferred sites during the treatment period. If these individuals engage in substitute behavior (e.g., recreating at a different site in the local area), there would be no impact to visitor spending. However, there would be social and nonmarket consequences to recreation displacement. Individuals may get less fulfillment or enjoyment from recreating at an alternate site, which would adversely affect quality of life. Due to the short duration and relatively few sites that would be expected to be affected, the quality of life implications of recreation displacement would be small.

Truck traffic volume would increase on Forest Service and nearby roads. Approximately 120,000 truck trips per year would be expected to result from 4FRI activities. The increased truck volume would increase commute times and the incidence of noise and dust in the vicinity. Individuals who use and live near those roads would have their quality of life adversely affected. A site specific design feature for dust abatement would minimize this effect (see appendix C for specific road segments where this would occur).

None of the alternatives would reduce employment and income relative to current conditions, therefore, no environmental justice issues related to disproportionate adverse economic effects would occur. The mill in Cameron, which is on the Navajo Nation, may benefit from increased supply from the 4FRI. However, any effect to the mill would likely be small. Changes in employment and income associated with the mill would more likely be affected by activities unrelated to the 4FRI, such as potential growth in Tuba City.

Smoke emissions resulting from wildfires and prescribed fires have health and quality of life consequences. Smoke would be most likely to affect vulnerable populations, children, the elderly, and individuals in poor health. Tribal areas in the Colorado River, Little Colorado River, and Verde River airsheds would be likely to experience air quality effects. Elders would be more likely to experience acute health effects. Limited communications technology, language barriers, and cultural differences may limit the effectiveness of informing residents of upcoming prescribed fires.

On both forests, the proposed forest plan amendments address management in MSO habitat, management of canopy cover, management of select areas for open reference conditions, and propose using vegetation and prescribed fire treatments in the proposed Garland Prairie Research Natural Area on the Kaibab NF (alternative C only). Economic activity would not be affected by the proposed amendments, therefore, their implementation (or not) would not lead to differences in local employment or economic efficiency. Social conditions would not be affected by the proposed amendments. Since no social or economic effects would result from implementation of the proposed amendments, low income and minority populations would not be disproportionately affected.

Alternative B – Direct and Indirect Effects

Under alternative B, wildfire suppression costs would, on average, decrease due to the restoration of fire-adapted forests. The decrease in wildfire suppression costs would allow more Forest Service expenditures to be directed toward forest health (e.g., fire management for resource benefit) and visitor services activities. The per acre administrative burden (cost of time and other resources) of planning, implementation, and monitoring forest restoration activities would be lower than alternative A. The 4FRI benefits from economies of scale—a single environmental compliance document addresses nearly 600,000 acres of restoration activities. Furthermore, the large treatment area would reduce cost to the government through increased private sector interest in engaging in harvesting and restoration activities on the forests. As shown in table 87, the 4FRI stewardship contracts have potential to provide a $100 million net benefit over the 10-year project period.

The environmental justice implications are described in the “Environmental Consequences Common to Alternatives B, C, and D” section.

Cumulative Effects

Forest restoration activities are emphasized in the existing and proposed forest plans in the region. Restoration activities would continue to occur in the region regardless of the 4FRI decision. Between 2001 and 2010, approximately 132,495 acres have been treated on the Coconino and Kaibab NFs. Ongoing and reasonably foreseeable projects will treat an additional 110,940 acres. Since 2000, approximately 80,000 acres (78,734) have been treated on private, State, and other federally managed lands in the project area. Reasonably foreseeable activities will treat 142,869 acres in the project area. These actions will occur regardless of the 4FRI selected alternative.

The effect of past, present, and reasonably foreseeable treatment activities in the project area would improve forest health relative to existing conditions even without implementation of the 4FRI. Under alternative B, due to the expected increase in the size of the timber harvesting and processing industry in the region, the local economic impact of current and future restoration activities would increase. The estimated employment and income consequences of non-4FRI treatment activities, therefore, are likely underestimated in the related environmental compliance documents.

Other ongoing and reasonably foreseeable vegetation treatments in the project area would reduce the opportunities for substitute behavior when the preferred recreation site is unavailable. As a result, individuals may choose to stay home, which would decrease visitor spending and consumer surplus to a greater extent than estimated in the direct and indirect effects analysis.

Planned expansions and improvements to recreation opportunities within the project area, however, may counterbalance the visitor use consequences of treatment. Increased recreation opportunities will increase both the number and appeal of substitute recreation activities in the study area.

The extent to which these two forces (vegetation treatment and recreation opportunity improvement) would balance each other is unknown. Therefore, the cumulative effects to the social and economic impacts from recreation cannot be precisely described. Based on available information, the net effect to visitor spending and consumer surplus from ongoing and reasonably foreseeable actions is not expected to change.

Alternative C – Direct and Indirect Effects

The direct and indirect effects are the same as described in alternative B.

Cumulative Effects

Cumulative effects are the same as described in alternative B.

Alternative D – Direct and Indirect Effects

The economic consequences are the same as described in alternative B.

Alternative D would treat the fewest acres with prescribed fire, which would reduce smoke emissions related to prescribed fire. However, alternative D would also be less effective than alternatives B and C in terms of reducing the risk and hazard of uncharacteristic wildfire. Therefore, severe wildfire smoke would be more likely under alternative D (and alternative A). Tribal areas in the Colorado River, Little Colorado River, and Verde River airsheds would be likely to experience air quality effects. Elders would be more likely to experience acute effects. Technological and cultural constraints to effective communication would make smoke effects more pronounced, as averting behavior is limited. However, burn plans written for implementation of the proposed prescribed fires would include modeling to determine the most appropriate conditions under which to burn in order to minimize smoke impacts. Since wildfire is unplanned, the potential for severe effects to human health and quality of life are higher during wildfire events. Under those circumstances, there would be with little warning, little control over the smoke, and a great deal more smoke than if prescribed fire was used.

Cumulative Effects

The cumulative effects are the same as described for alternative B.

Recreation

A summary of the recreation report is presented here and the specialist report (Minor 2013) is incorporated by reference. The potential impact of the project to recreational opportunities was not raised as a concern by the public. Please refer to the specialist report for methodology, data, and supporting information.

This analysis evaluates the following questions in order to respond to/meet forest plan direction:

- Would project activities affect provision of a variety of recreation opportunities? (Measure: acres of opportunities provided.)
- Would smoke from pile burning and prescribed fire affect provision of recreation opportunities? (Measure: describe and compare potential effects.)
- Would the proposed restoration activities diverge from reference conditions identified for the forest and in the mapped recreation opportunity spectrum (ROS) settings? (Measure: acres meeting ROS settings.)
- Would proposed road construction or other management activities result in inconsistencies in the designated ROS classes in the project area? (Measure: miles of roads or acres of treatment in ROS classes impacted by roads in the project area.)
- Would proposed temporary road construction or other management activities result in inconsistencies in the designated ROS classes in the project area? (Measure: miles of roads or acres of treatment in ROS classes impacted by roads in the project area.)

Affected Environment

The Coconino and Kaibab NFs provide diverse outdoor recreation opportunities, connecting people with nature in a variety of settings. See the specialist report for maps that display general locations of recreation settings within the project area. The 4FRI project area is included in the Northern Arizona Council of Governments (NACOG) region that includes Coconino, Navajo, Apache, and Yavapai Counties. In comparison with Arizona State figures, more residents in the NACOG region participate in outdoor recreation activities more times throughout the year than in other regions of Arizona. The entire list of activities people participate in is available on the FS Natural Resource Manager Web site (http://apps.fs.usda.gov/nrm/nvum/results/).

According to national visitor use monitoring (NVUM), most visitors to the Coconino NF use day-use developed sites (such as picnic areas, observation points, and trailheads) and undeveloped areas (the general forest area with no developed facilities). On the Kaibab NF, the majority of visitors use overnight developed sites (campgrounds) and day-use developed sites. In all of these sites, visitors may engage in a number of different recreation activities (they are not limited to camping when staying at a campground). See the socioeconomic report for additional information on population growth, demographics, and tourism related economics that affects recreation use.

There are approximately 220 miles of dispersed camping corridors along the designated road system on the Coconino NF portion of the project where restoration activities would take place.

This represents about 37 percent of designated camping corridors on the Coconino NF. About 4.2 percent of visitors to the Coconino report that they dispersed camp in undeveloped areas (USDA 2012). The Kaibab NF provides short road segments for recreation access including dispersed camping. Less than half of the short road segments would be affected by restoration activities. Approximately 9.2 percent of recreationists indicated that they dispersed camp in undeveloped areas (USDA 2012c).

The recreation opportunity spectrum (ROS) is a classification system that describes different outdoor recreation settings across the forests using seven standard classes that range from primitive, undeveloped settings to urban, highly developed settings. Attributes typically considered in describing the settings are size, scenic quality, type and degree of access, remoteness, level of development, social encounters, and the amount of onsite management. Over 60 percent of the project is in the roaded natural ROS class, approximately 20 percent is in semiprimitive motorized, and there is less than 10 percent in each of the remaining classes. The 4FRI project does not include restoration activities in developed recreation sites, special areas, or designated wilderness. ROS classes and miles of road by ROS class are displayed in tabular and map form in the specialist report.

Throughout much of the project area, numerous resource management activities have occurred including vegetation management, road maintenance, developed recreation site construction, trail construction and maintenance, prescribed fires, hazard tree removal, utility corridor clearing, and others. In addition, there have been numerous wildfires in the area. Not all projects have met or currently meet the characterizations and mapped ROS classes at this time.

Environmental Consequences

The environmental consequences are organized to sequentially follow the analysis questions presented earlier. The environmental consequences are based on the application of design criteria and mitigation developed to eliminate or reduce adverse effects of the proposed actions on sensitive resources. See the “Recreation” section of appendix C in the DEIS.

Alternative A – Direct and Indirect Effects

There would be no immediate direct, indirect, or cumulative effects on existing recreational settings or facilities. Since no direct management actions would occur, the existing recreational settings would not change. Although stand densities would remain unnaturally high in much of the project area, some visitors are not aware of the unnatural condition of the forest, and their experience and perception of forest conditions would continue to be largely positive.

In the short term, there would be no change in recreation opportunities. In the long term, up to 589,923 acres could be affected in the event of large-scale, high-intensity wildfire or insect or disease outbreak. There would be no effects to recreation opportunities from pile burning or prescribed fires.

The ROS settings are currently natural appearing, but forest conditions make the settings vulnerable to wildfire and insect or disease outbreaks. There would be no change from existing conditions to ROS.

Cumulative Effects

The cumulative effects area is the ponderosa pine forest on the Coconino and Kaibab NFs. The cumulative effects period is 20 to 30 years. Past human activities and natural disturbance processes have influenced the current condition of the project area. Management activities and natural processes have affected, or continue to affect, vegetation structure, spatial arrangement and pattern, composition and diversity, natural processes (such as fire), and movement toward increased forest resiliency and function. The specialist report provides an overall assessment of positive and negative cumulative effects of past, present, and future projects on recreation.

Cumulatively, the no action alternative (when considered with past, present, and future projects) would not immediately change recreation opportunities and the associated recreation settings on the forests. Increased demand for ponderosa pine forest settings is expected. This alternative is expected to result in declining forest health, unhealthy stands (that have resulted from past wildfires and past timber sales), and a less sustainable forest. There would be a decline in the quality and availability of satisfactory recreation settings as well as the slow decline in provision of distinct ROS classes.

The no action alternative would result in the forest being more susceptible to large intensity wildfire or beetle attack. This would result in a decrease in recreation opportunities while at the same time, the desire for recreation use is increasing as a result of population growth and the public is increasingly dependent on national forests for recreation and leisure activities. Thus, this alternative would result in a cumulative decrease in the ability of the Coconino and Kaibab NFs to meet recreation demands over the long term.

Past vegetation management activities have resulted in an even-aged forest structure that is generally undesirable for recreation settings. It has contributed to the scarcity of large, mature trees and a lack of open structure—two setting characteristics (Ryan 2005) that have been identified as desirable to forest users. Past fire suppression activities have contributed to overstocked forest conditions, increased fuels, and decreased understory vegetation health. The current and planned vegetation management treatments and burning projects on both forests—as well as opportunities for managed wildfire—result in cumulative improvements in forest health and sustainability in the ponderosa pine, but are at such a small scale that benefits to the recreation settings in the ponderosa pine forest on the Coconino and Kaibab NFs are small and localized. In the event of a large, high-intensity wildfire, or large scale insect infestation resulting from existing conditions, the desired recreation settings and ROS class characteristics forest users seek would be so altered that the cumulative effects would result in a lack of desired recreation settings and long-term changes in ROS classes.

Motorized travel management implementation, in combination with the no action alternative, is expected to have mostly positive effects on recreation settings due to prohibition of cross-country motorized travel. The quality of many recreation settings in ROS classes were declining due to increased motorized use and increasing occurrences of cross-country travel. Present and future activities may result in degradation along heavily used camping corridors, but these would be small and localized.

Desired recreation setting characteristics such as large, mature trees, healthy understory, and diversity of tree age classes, sizes, and species are also at high risk from the effects of climate change. While drought cycles are common in the Southwest, increasing temperatures and decreases in precipitation in combination with overstocked forest conditions and high fuel loads are predicted to result in an increase in high-intensity wildfires (Westerling et al. 2006, Marlon et al. 2012, University of Arizona 2012). Unmanaged forests have shown increases in tree stress and mortality as a result of global warming, and old, mature trees are especially vulnerable (Ritchie 2008, Van Mantgem et al. 2009, Williams et al. 2010). Increased tree mortality and loss of large, mature trees would result in a cumulative decrease in recreation settings.

Alternatives B, C, and D Direct and Indirect Effects

Alternative B - Recreation Opportunities

There would be short term and temporary decreases in the provision of recreation opportunities on parts of the Coconino and Kaibab NFs. Some forest users would be dissatisfied with their lack of access to portions of the project area during management activities such as thinning projects and prescribed fires. Areas may be closed to the public due to hazardous conditions which would result in forest user displacement and user dissatisfaction.

There could also be an increase in crowding in nearby open forest areas. Since this project would affect 40,000 acres at one time, or 2 percent of the south Kaibab and Coconino NFs, it is unlikely that crowding ratings would increase more than 25 percent in areas that have already been identified as having crowded conditions.

Direct effects of pile burning, prescribed fires, and fire line preparation are the potential for short-term displacement of recreationists during implementation (campers may need to be moved out, trail users may not be able to use a trail during firing operations), or visitor dissatisfaction (seeing slash piles or pile burning, smoky conditions from pile or prescribed fires while people are visiting the area); however, these effects are expected to be of short duration and intensity (fire line preparation would likely last less than a year and smoky conditions in any one particular area are likely to last a week or less).

Indirect effects would include recreation user displacement (potentially including trail users, hunters, anglers, winter users, firewood gatherers), increased use of special areas and designated wilderness, and potential crowding in areas not receiving forest management treatments. Restoration activities would help to assure long-term provision of recreation opportunities.

Mitigations that include provision of information about treatment and burning locations would help to inform visitors of places to avoid or other locations that are not receiving active treatments. Mitigations to provide information about the location of restoration activities as well as places where there are no activities planned may help reduce visitor frustration about finding a camping location and assist campers in making choices about where they will engage in camping activities (see the “Recreation” section in appendix C of the DEIS).

Recreation Settings

Direct and indirect effects to recreation settings from mechanical treatments would result in short term (immediate to 5 years), temporary changes in up to 72 percent of ROS settings quality (urban to roaded natural) in the project area. The short-term effects would persist one or more seasons until activity slash is treated and the treated area recovers to an “unaltered” or “undisturbed” natural appearance.

Effects of mechanical treatments are expected to take longer (immediate to 10 years) to recover in the two semiprimitive ROS settings since these would have less evidence of treatment or development to begin with and would require more time to naturalize. Twenty-eight percent of the project area is in the two semiprimitive ROS settings in the project area. Mitigation measures have been designed to ensure that direct effects of project activities are short term, and important recreation values are protected in the long term. ROS classes are expected to be changed 1 to 5 years after treatment, but following completion of vegetation treatments should display many of the characteristics described for each setting.

As required in the Kaibab NF forest plan, temporary changes in ROS classes are documented in the recreation report and the timeline for meeting the mapped ROS classes is 15 years from the beginning of project implementation (5 years following the last projected treatment). There would be one exception to this for aspen treatments. Since these activities require fencing or creation of barriers until trees can withstand ungulate grazing, it is anticipated aspen stands would not meet desired ROS classes until at least 20 years following project implementation.

There would be short term and temporary changes in ROS classes as well as decreases in the scenic quality of trailside recreation settings due to restoration activities (see report for examples). Following completion of treatments, trailside settings are expected to naturalize quickly (within 1 to 3 years) and the scenic quality of the settings would be improved.

There would be short-term disturbance and temporary changes in ROS classes and roadside recreation settings during road reconstruction. Recreation visitors may be inconvenienced and have to wait during some activities, or roads may be temporarily closed causing displacement. Long-term effects would be improved water quality at stream crossings, and safer and better maintained roads for forest user enjoyment (see the soils and water quality and riparian report).

Decommissioning of existing and unauthorized roads would improve recreation settings over time and would improve ROS classes. Temporary road construction would result in short-term disturbance and temporary changes in ROS classes. New linear features would be added to recreation settings reducing the scenic quality for 3 to 10 years. There may be some increase in illegal motorized vehicle use of these roads until they are decommissioned. Once these roads have been decommissioned, they are usually not apparent to the casual user. Mitigation measures would be used to close off entrance and exit locations of these roads, as well as use of BMPs (see appendix C of the DEIS). Opening closed roads would have similar effects as reopening temporary roads; however, decommissioning would result in the roads revegetating and becoming natural appearing over time. Since these roads would not be reopened, in the long term the decommissioned roads would meet and improve ROS classes.

Spring improvements would improve and meet ROS classes. Channel restoration would improve recreation settings over time. There would be short to moderate term changes in ROS settings where aspen are treated. Ephemeral channel restoration fencing and aspen restoration fencing and jackstrawing would cause temporary changes in the ROS class setting characteristics since the natural appearing environment would be somewhat altered. When fencing is removed or jackstrawed trees burn or begin to break up and decompose, treatment areas would meet ROS classes. This alternative would provide for restoration treatments along both utility corridors and road rights-of-way. Mitigation measures that include feathering abrupt edges of corridors and rights-of-way should result in ROS class compliance. Based on information compiled for this project (Noble 2013), the mechanical treatments would improve all understory characteristics.

Thinning and prescribed fire would increase most understory characteristics with the possible exceptions of shrubs and Gambel oak. A healthier, more varied understory would result in improved recreation settings on at least 388,489 acres where thinning and prescribed fire would occur, as well as some improvement on 199,435 acres of prescribed fire only.

This alternative provides for the long-term protection of recreational settings and facilities on 388,489 acres where mechanical thinning and burning would occur by improving stand conditions and reducing fuel loading, and would lower the risk of high-intensity fire somewhat on 199,435 acres where prescribed fire would occur. Maintaining healthy, green forests and reducing the risk of large-scale, high-intensity fires in the project area would have a positive effect on protecting and maintaining high quality recreation settings into the future.

Forest Plan Amendments

Coconino NF

Three nonsignificant forest plan amendments (see appendix B) would be required on the Coconino NF to implement the proposed action:

- **Amendment 1** would amend the Coconino forest plan to comply with the new MSO recovery plan's desired conditions, standards and guidelines, and monitoring. While constructed features such as trails or recreation sites are generally placed outside of PACs, older trail alignments or recreation sites may precede delineation of these areas, and may be located within or adjacent to PACs. For recreation, this would result in potential reductions in the risk of wildfire in MSO PACs compared to compliance with the existing forest plan language and direction. It would also open up these PACs, somewhat creating the potential for views beyond the immediate foreground. This would have a slight positive effect on recreation settings and scenic quality associated with the settings.
- **Amendment 2** would result in making progress toward the desired forest structure and move about 29,000 acres toward historic reference conditions. It would help to meet the desired conditions of restoring natural processes and forest health and providing for high scenic and recreational values. It would also meet Coconino forest plan goals and objectives for recreation including: "Manage the recreation resource to increase opportunities for a wide variety of developed and dispersed experiences" and "there is a range of recreational setting opportunities for people to enjoy the area's many scenic and aesthetic qualities. The diversity and quality of recreation opportunities, settings, and experiences are within acceptable limits of change to ecosystem stability and condition." It would make more progress toward restoration than implementing the existing forest plan direction. There would be improvement in recreation settings and scenic quality associated with the settings.
- **Amendment 3** would allow for managing to achieve a "no adverse effect" determination for significant, or potentially significant, inventoried heritage sites. This amendment would not affect recreation resources associated with this project.

Kaibab NF

Two nonsignificant forest plan amendments (see appendix B) would be required on the Kaibab NF to implement the proposed action:

- **Amendment 1** would result in making progress toward desired forest structure and move about 27,000 acres toward historic reference conditions. It would help to meet the desired conditions of restoring natural processes and forest health and providing for high scenic and recreational values. It would also meet Kaibab forest plan goals and standards for recreation: "Manage a wide spectrum of desired settings that provide opportunities for the public to engage in a variety of developed and dispersed recreation activities, in concert with other resource management and protection needs" and "Where existing conditions do not meet mapped ROS or SIOs, design and implement project to move the area toward desired conditions."
- **Amendment 2** would not affect recreation resources associated with this project.

Cumulative Effects

The cumulative effects area for alternative B is the ponderosa pine forests on the Coconino and Kaibab NFs, and the cumulative effects period is 20 to 30 years.

Past human activities and natural disturbance processes have influenced the current condition of the project area. Management activities and natural processes have affected, and continue to affect, vegetation structure, spatial arrangement and pattern, composition and diversity, natural processes (such as fire), and movement toward increased forest resiliency and function. The specialist report provides an overall assessment of positive and negative cumulative effects of past, present, and future projects on recreation.

The cumulative effects of alternative B and past, present, and future projects would have short term and local negative cumulative effects on the provision of recreation opportunities and the associated recreation settings on the forests. Forest users seeking ponderosa pine recreation settings may be displaced or restricted, and the quality of recreation sites may temporarily decrease during management activities for this project and other current or future projects.

Alternative B would restore the ponderosa pine forest health and sustainability to over 500,000 acres; this, combined with other restoration activities, would decrease the risk of high-intensity wildfire or large insect outbreaks. Increasing numbers of recreation users and demand for ponderosa pine recreation settings will continue to strain the Agency's capacity and in some areas of concentrated use, the resource capacity. With increasing demand for ponderosa pine forest settings, the large-scale improvements to forest health and sustainability of this project and similar vegetation and burning projects such as Upper Beaver Creek Forest Restoration, Hart Prairie Forest Restoration, Marshall Forest Restoration, Rim Lakes Forest Restoration, and others are expected to result in cumulative retention or improvement in the quality of recreation settings and an increase in the ability of the Coconino and Kaibab NFs to meet recreation demands over the long term.

Past vegetation management activities have resulted in an even-aged forest structure that is generally undesirable for recreation settings. It has contributed to the scarcity of large, mature trees, and a lack of open structure—two setting characteristics (Ryan 2005) that have been identified as desirable to forest users. Past fire suppression activities have contributed to overstocked forest conditions, increased quantities of fuels, and decreased understory vegetation. The current and planned vegetation management treatments and burning projects on both forests, as well as opportunities for managed wildfire, cumulatively result in improvements in forest health and sustainability in the ponderosa pine that are large and widespread. In the event of a wildfire or insect infestation, the restored forest would likely experience more typical low-intensity fire and small scale insect infestation. The cumulative effects to desired recreation settings and ROS class characteristics forest users seek would be maintained and improved.

Utility corridor clearing in combination with alternative B would result in short term and localized negative cumulative effects on both forests.

Motorized travel management implementation in combination with alternative B is expected to have mostly positive effects on recreation settings due to prohibition of cross-country motorized travel and decommissioning of user-created routes and some existing forest roads. The quality of many recreation settings in ROS classes were declining due to increased, unconfined motorized use and increasing occurrences of cross-country travel. Present and future activities may result in additional degradation along camping corridors, but these would be short term and localized. There would be positive cumulative effects and an overall improvement in ROS classes as a result of these activities. In some areas, motorized restrictions resulting from travel management implementation may combine with temporary access restrictions that would be necessary under this alternative to make portions of the forests unavailable for motorized access.

Road and trail construction projects in combination with alternative B would result in negative effects to small and localized recreation settings across both forests. Little new road construction is proposed now or in the future. Motorized trails projects (proposed in other projects) include new construction, road to trail conversion, and route decommissioning in appropriate ROS classes. This would have positive cumulative effects in more primitive ROS classes when decommissioned routes naturalize, and expected characteristics are reestablished.

Desired recreation setting characteristics such as large, mature trees, healthy understory, and diversity of tree age classes, sizes, and species are also at high risk from the effects of climate change. While drought cycles are common in the Southwest, increasing temperatures and decreases in precipitation in combination with overstocked forest conditions and high fuel loads are predicted to result in an increase in high-intensity wildfires (Westerling et al. 2006, Marlon et al. 2012, University of Arizona 2012). Unmanaged forests have shown increases in tree stress and mortality as a result of global warming, and old, mature trees are especially vulnerable (Ritchie 2008, Van Mantgem et al. 2009, Williams et al. 2010). Alternative B and other restoration projects would cumulatively result in improved forest structure, composition, and diversity and more resilient forest conditions with decreased tree stress and potential for decreased mortality.

Alternative C – Direct and Indirect Effects

Recreation Settings

The effects described in alternative B would be the same for alternative C with the exception of the number of acres restored. Approximately 10 percent more acres would receive restoration treatments and this would further reduce the risk of large-scale, high-intensity fires in the project area. This would have a slightly more positive effect on protecting and maintaining high quality recreation settings over time. Alternative C would result in 10 percent more temporary changes in

ROS classes during project implementation. Assuming a linear relationship, up to 10 percent more forest users would be affected by the additional treatments.

Alternative C would construct up to 15 weirs and 20 weather stations (disturbing approximately 3 acres) as part of watershed improvements and metrics. Effects to recreation settings would be to increase the visibility of human disturbances on 3 acres within the project area. Mitigation measures are included in order to assure that constructed features use natural or natural appearing materials that reduce the visibility and contrast as much as possible (see appendix C of the DEIS).

Recreation Opportunities

There would be some reduction of recreation opportunities during active forest thinning and prescribed burning. It is estimated that there would be a 10 percent increase or about 66,000 acres could be affected at one time. Areas may be closed to the public due to hazardous conditions which would result in forest user displacement and user dissatisfaction. There could also be an increase in crowding in nearby open forest areas. The effects from pile burning (smoke) are the same as described in alternative B.

This alternative would provide for the long-term protection of recreational settings and facilities on 434,001 acres where mechanical thinning and burning would occur by improving stand conditions and reducing fuel loading, and would lower the risk of high-intensity fire somewhat on 159, 211 acres where prescribed fire only would occur. Maintaining healthy, green forests and reducing the risk of large-scale, high-intensity fires in the project area would have a positive effect on protecting and maintaining high quality recreation settings into the future.

See alternative B for roads and other management activities. Weir construction (see alternative C description) would result in short-term decreases in ROS classes. Mitigation measures (see appendix C of the DEIS) would be used so that natural or natural appearing materials are used in weir construction, and the landscape architect would be involved in design of the fixtures so that they would meet the ROS class.

Forest Plan Amendments

Coconino NF

Three nonsignificant forest plan amendments (see appendix B) would be required on the Coconino NF to implement alternative C:

- **Amendment 1:** Increase the size of trees that could be removed in 18 MSO PACs and could allow use of low-intensity prescribed fire within 56 PAC core areas. Old, large diameter trees are often an important part of the scenic quality of recreation settings. While constructed features such as trails or recreation sites are generally placed outside of PACs, older trail alignments or recreation sites may precede delineation of these areas and may be located within or adjacent to PAC's. For recreation, this would result in more potential reductions in the risk of wildfire in MSO PACs compared to compliance with existing forest plan language and direction and more than would be implemented in action alternatives B or D. It would open up these PACs more, creating the potential for views beyond the immediate foreground. This would have a somewhat greater positive effect on recreation settings and scenic quality associated with the settings than action alternatives B or D.

- **Amendment 2**: The effects to recreation would be the same as with alternative B.
- **Amendment 3**: There would be no effects to recreation resources from implementation of this amendment.

Kaibab NF

Three nonsignificant forest plan amendments (see appendix B) would be required on the Kaibab NF to implement alternative C:

- **Amendment 1**: The effects of this alternative would be the same as for alternative B.
- **Amendment 2**: The effects of mechanically treating and prescribed burning Garland Prairie RNA would be similar to those described earlier in this chapter for savanna treatments. There would be short-term (1 to 5 years) disturbances that would temporarily lower the scenic quality of RNA settings. In the long term, these treatments would result in improved plant vigor and species diversity (Noble 2013) that would be positive for scenic drivers, hikers, equestrians, and others.
- **Amendment 3** would have no effects on recreation resources.

Cumulative Effects

Cumulative effects of alternative C are the same as alternative B. The other projects such as construction of weirs and weather stations would result in no or very small, localized cumulative effects.

Alternative D

Direct and Indirect Effects

The short term and temporary decreases in the provision of recreation opportunities on the Coconino and Kaibab NFs and dissatisfaction would be the same as described in alternative B.

This alternative has the most risk of damage due to human-caused fire starts since only about a quarter of the area would receive prescribed fire treatments. Studies have shown that hikers demand decreased slightly in areas recovering from crown fire and increased in areas recovering from prescribed fire (Hesseln et al. 2004).

The completion of restoration activities would provide some protection of 388,489 acres across both national forests from mechanical thinning, but less than alternatives B or C because prescribed burning would occur on only 178,790 acres or 30 percent of the project area. The proposed activities would help to assure provision of recreation opportunities, but these would be limited since prescribed fire would not be used to help maintain forest health and resilience.

Direct effects of vegetation management and mitigation measures are the same as for alternatives B and C. See the “Scenery” section for impacts to scenic quality in terms of recreation settings.

Direct effects of pile burning, prescribed fire, and fire line preparation have the least potential for short-term displacement of recreationists during implementation since much less area would be treated through these methods. This alternative would cause the fewest days of smoky conditions due to pile burning or prescribed fire. Fire line preparation would occur on about one-quarter of the area, the least of the action alternatives.

The immediate effects of pile burning include small (less than 1/10 of an acre) bare, blackened areas on 99 acres that may persist in this condition until vegetation begins to move in or sprout usually within 1 to 3 years following burning. Prescribed fire would occur on about one-third of the project area. The immediate effects following prescribed burning are the same as described in alternatives B and C.

The effects of roads on recreation resources would be the same as alternatives B and C.

There are approximately 357 miles of dispersed camping corridors along the designated road system on the Coconino NF portion of the project where restoration activities would take place. This represents about 61percent of designated camping corridors on the Coconino NF. About 4.2 percent of visitors to the Coconino report that they dispersed camp in undeveloped areas. The direct effects of alternative D would be similar or slightly greater than alternative B or C since processing slash—whether by chipping/shredding/mastication and/or hauling—would take longer to complete than cutting and burning, and the machinery used to process slash would result in longer reduction of natural quiet. Winters (2002) found greater support through average approval ratings was found for signs at recreation sites, seasonal closures, restrictions on use, and controlled burns; less support was indicated for mechanical interventions.

Initial ground recovery may be faster with slash removal and less prescribed fire, but the potential for crown fire or high intensity ground fire is reduced on only a third of the treatment acres. There would still be some camper displacement along some of the designated camping corridors during implementation when there are temporary closures.

Indirect effects of mechanical treatments on both forests in terms of crowding in designated camping corridors would be similar as described in alternatives B and C with mechanical treatment-only areas having slash treated with mechanical methods or removal. However, initial recovery would be faster than those areas receiving prescribed fire, but the risk of fire starts would be greater with this alternative.

There may be longer hiking and motorized user temporary closures with alternative D since slash would be mechanically treated: chipped/shredded/masticated or transported away from the site. There would be shorter temporary closures associated with prescribed fire activities since only a third of the treatment area would be burned.

There would be short-term and temporary changes in ROS classes as well as decreases in the scenic quality of trailside recreation settings due to restoration activities. These could include visible skid trails and log landings on nearby roads, increased noise from mechanical thinning, and slash treatment or removal. There would be 99 acres of blackened areas where slash piles would be burned. Following completion of treatments, trailside settings are expected to naturalize quickly (within 1 to 3 years) and the scenic quality of the settings would be improved. Understory vegetation would respond, but not as much as alternative B or C. The effects to hunters, anglers, and firewood gathering are the same as described in alternatives B and C.

Direct and indirect effects to recreation settings of mechanical treatments would be a short term, temporary change in ROS setting quality until the effects of logging and slash treatment activities fade and become vegetated and the treated area recovers to an “unaltered” or “undisturbed” natural appearance. Mitigation measures would ensure that direct effects of project activities are short term, and important recreation values are protected in the long term.

This alternative does less than alternative B or C to provide for the long-term protection of recreational settings and facilities on the project area since total prescribed fire would be reduced to 178,790 acres. Stand conditions would be improved from thinning, but fuels loading would be reduced on only about a third of the project area. The risk of high-intensity fire would be the greatest of all action alternatives, but less than the no action alternative. This alternative has the least positive effect in terms of moving toward desired conditions and protecting and maintaining high quality recreation settings into the future.

Slash resulting from mechanical treatments would be disposed of through various methods including chipping, shredding, mastication, and removal of biomass offsite. These methods would best protect the scenic quality and natural appearing quality of ROS classes and recreation settings of all alternatives. However, these slash treatment methods also contribute to already high fuels loadings and would increase the risk of high-intensity wildfire occurring (see fire ecology report).

The effects to ROS classes from roads, springs, channels, aspen, utility corridors, and road rights-of-way treatments are the same as described in alternatives B and C.

The understory is expected to be improved but not as much as alternatives B and C. About one-quarter of the area proposed for restoration would have well improved recreation settings, the remainder would have somewhat improved recreation settings.

Alternative D would result in some reduction of recreation opportunities during active forest thinning and prescribed burning, and potentially longer slash treatment duration than alternative B or C. It is estimated that up to one-tenth of the project area, or about 40,000 acres, could be affected at one time. Areas may be closed to the public due to hazardous conditions which would result in forest user displacement and user dissatisfaction. There could also be an increase in crowding in nearby open forest areas.

Smoke from pile burning would be minimal with alternative D. Only 99 acres would be thinned, hand piled, and burned.

Smoke from prescribed fire would occur on about a third of the acreage as alternative B or C. Short-term effects are the same as described in alternatives B and C. This alternative provides for the long-term protection of recreational settings and facilities on 388,489 acres where mechanical thinning would occur, improving stand conditions, and would reduce the fuel loads on 178,790 acres where prescribed burning would occur. The risk of high-intensity wildfire would be lessened in the short term, but lack of prescribed fire and repeat burning would result in increasing risk of wildfire over time.

The quality of scenery viewing would be reduced in the short term (1 to 3 years) during project implementation due to logging operations, but because slash would be treated or removed rather than being piled or burned, these effects would be shortened and reduced. Prescribed fires would occur on about 178,753 acre with short-term effects. The areas would begin to recover and naturalize. Mitigation measures to provide information about scheduled burns would be available so that recreation visitors could make informed decisions about choosing the places they recreate.

The effects of spring improvements, ephemeral channel improvements, and fencing would be the same as with alternatives B and C. Effects of utility corridor and road rights-of-way would also be the same.

Forest Plan Amendments

Coconino NF

Three nonsignificant forest plan amendments (see appendix B) would be required on the Coconino NF to implement alternative D:

- **Amendment 1**: The effects of this forest plan amendment would be the same as with alternative B.
- **Amendment 2**: The effects to recreation from this plan amendment would be the same as alternatives B and C.
- **Amendment 3** would have no effect on recreation resources.

Kaibab NF

Two nonsignificant forest plan amendments (see appendix B of the DEIS) would be required on the Kaibab NF to implement the proposed action:

- **Amendment 1**: The effects of this amendment would be similar to alternatives B and C.
- **Amendment 2** would have not effects on recreation.

Cumulative Effects

The cumulative effects boundary and timeframe is the same as described in alternative B.

Alternative D would result in the forest being more susceptible to wildfire. The effects of this alternative and other projects would result in a declining quality of recreation opportunities while at the same time, the desire for recreation use is increasing as a result of population growth and the public is increasingly dependent on national forests for recreation and leisure activities. Thus, this alternative would result in a cumulative decrease in the ability of the Coconino and Kaibab NFs to meet recreation demands over the long term, although not as much as the no action alternative.

The impact of past vegetation management activities and fire suppression activities are the same as described in alternative B. The current and planned vegetation management treatments and burning projects on both forests, as well as opportunities for managed wildfire result in cumulative improvements in forest health and sustainability in the ponderosa pine, but these are limited in scope and would have less of a cumulative effect in ponderosa pine forest types on the Coconino and Kaibab NFs since the quantity of prescribed burning under this alternative would be greatly reduced. This would result in more localized benefits to the recreation settings in the ponderosa pine forest on the Coconino and Kaibab NFs and less of a cumulative benefit toward maintaining resilient ponderosa pine forest types to provide recreational opportunities.

In the event of a wildfire, there would be a greater chance of high intensity ground fire as a result of high fuels loadings. Since wildfire risks are only reduced a third as much in alternative D, the desired recreation settings and ROS class characteristics forest users seek would be altered, and the cumulative effects would result in a lack of desired recreation settings and long-term changes in ROS classes.

This alternative would likely require additional mechanical means to chip or haul activity slash resulting from thinning activities. This would likely result in temporary restrictions to parts of the forest that may combine with motor vehicle restrictions included with travel management implementation to restrict vehicle access to larger parts of the forest, thus temporarily decreasing recreation opportunities, but not necessarily recreation quality. These cumulative impacts on recreational opportunities are expected to be localized to where the treatment work is taking place and would be limited to weeks or months in time.

Desired recreation setting characteristics such as large, mature trees, healthy understory, and diversity of tree age classes, sizes, and species are also at high risk from the effects of climate change. Alternative D and other vegetation management projects would cumulatively result in improved forest structure, but less improvement in forest composition and diversity. The forest resilience would be improved in the short term, but risk of wildfire would still be high and with it, the potential for large-scale fires that could kill many trees, including vulnerable old, mature trees.

Lands and Minerals

A summary of the lands and minerals report is presented here. The specialist report (Rowe 2012) is incorporated by reference. See the report for the complete methodology and analysis process.

No key issue (large trees, emissions from prescribed fire, or post-treatment landscape openness) addressed in the DEIS has any effect on lands special uses and/or minerals and, therefore, they do not serve as indicators for analyzing the effects of the project on these resources. However, the project would have an indirect effect in the form of reduced fire risk. Therefore, the indicator used for this analysis is the number of acres with reduced fire risk.

Lands Special Uses

Lands special use authorizations include permits, term permits, leases, and easements that authorize occupancy and use of National Forest System lands. Authorized activities include uses such as utility corridors, roadways, communications sites, and research projects, as well as many other uses. The terms of these authorizations vary based upon the type of use.

As of March 2012, there were 496 active lands special use permits in the project area. Additionally, there are approximately 30 to 40 temporary permits issued each year for commercial filming, photography, and other short-term uses. Research permits are also regularly issued within the project area; while many are short term in nature, there are also long term research permits.

Most lands special use permits allow vegetation clearing around the facilities they authorize to provide for access and/or fuel reduction. Within the project area, the bulk of this vegetation treatment occurs in association with power, gas, and other utility corridors. Of the 496 permits in the project area, 37 fall into this category. They represent approximately 32,345 acres of vegetation that are being managed regularly. Not all of these acres lie within the project area, however, as permit acreages are recorded for the entire authorization and generally not broken down by township and range.

Recent years show an increasing demand for lands special uses. As development in communities in and around the forests increase, their need to utilize public lands in support of their infrastructure will also increase. Proposals for powerlines, rights-of-way, communications sites, water transmission lines, and roadways have increased steadily and will continue to do so in future years. Increased interest in renewable energy sources, such as wind and solar, has also contributed to the increased demand.

Minerals

Locatable minerals production on the Coconino NF includes manganese, gypsum, flagstone, and pumice. Saleable minerals production includes cinders, crushed aggregate, fill rock and dirt, and landscape rock. There are no oil or gas leases. Potential geothermal resources are associated with the San Francisco Volcanic Field.

Presently, no known coal, oil, or gas reserves are located on the Kaibab NF. The primary economic mineral resource consists of limited locatable mineral deposits. Many are small and, in today's economic climate, not commercially viable. There are, however, uranium deposits that are of higher grade than approximately 85 percent of the world's known uranium deposits (International Atomic Energy Agency 2009; World Nuclear Association 2009; as cited in the special uses-minerals-lands specialist report for the Kaibab forest plan revision, 2011). Salable minerals consist of sand and gravel deposits, building materials, and cinders. The area of the Tusayan district that was designated as part of the Grand Canyon Game Preserve is withdrawn from mineral entry.

The "Coconino-Kaibab Rock Pit Environmental Analysis," currently underway, would allow the use and development of 19 rock pits on the Coconino NF and 20 on the Kaibab NF. Many of these pits would be new sources. Most of the rock would be used by the forests, but some may be made available for sale to counties, cities, and other agencies.

Environmental Consequences

Alternative A

Under this alternative, no restoration activities would occur. Stand and vegetation structures would not be improved, which would make the landscape in the project area less resilient to disturbance and would provide increased fuels for wildland fires. Increased fire danger, and the potential for increased intensity of wildland fires, would impact lands special uses by threatening the structures they authorize in both the short term (10 years) and long term (20 years and more). Any structures associated with active minerals sites would also be similarly threatened. Long-term effects could be the destruction of these facilities by fire, and possibly the closure of fire-damaged areas for rehabilitation. There may be short term, temporary effects in the form of restricted access to sites during fire suppression activities or post-fire rehabilitation. See the fire ecology report for detailed information on existing and foreseeable fire risk.

Effects of All Action Alternatives (B, C, and D)

All action alternatives would improve forest health by providing for a variety of restoration activities. While they vary in specific approaches, the overall effect on lands special uses and minerals would be the same. Increased forest health would lower the risk wildland fires and lower the potential for fires of high intensity. This would reduce the threat to the structures authorized for lands special uses and mineral projects.

Of the action alternatives, alternative C treats the most acres; therefore, it provides the greatest improvement to forest health and reduced risk of fire.

All action alternatives would require construction of 524 miles of temporary roads and the reconstruction of 10 miles of existing roads, which would result in increased demand for mineral materials for road surfacing. This could result in the need for new source pits, if existing pits proved insufficient. It could also result in the need for new source pits in the future, if existing pits are depleted by this project.

There could be short term, temporary impacts to land special uses and mineral projects as site-specific restoration activities were implemented. For example, access to sites may be temporarily restricted while thinning or burning was occurring. The duration of these impacts would be only as long as the site-specific activities were occurring, for example, the amount of time that thinning was occurring in the vicinity of a particular permit area or mineral site. Prior to any site-specific implementation, the Forest Service would work with affected permit or claim holders to determine site-specific concerns, such as timing restoration activities to avoid periods of high use or access needs by the permit holders. Such mitigation would minimize potential adverse effects to these resources. Under all alternatives, there is no foreseeable irretrievable or irreversible commitment of resources.

Effects of Forest Plan Amendments Under Each Action Alternative

Each action alternative would require amendments to one or both forest plans. Because each amendment addresses a specific resource concern, potential effects are analyzed in terms of the management prescription and how it would affect lands and minerals special uses (rather than in terms of acres treated). Analysis is presented in terms of "additional effects," meaning those beyond what would be imparted by the alternatives themselves.

Amendments Addressing Mexican Spotted Owl (MSO)

These are the most complex amendments being considered under the project, because they address six different elements in managing MSO habitat and because the proposed amendment language for four of these elements varies for each alternative. Additionally, two elements apply only to the Coconino NF and one applies only to the Kaibab NF. These amendments are summarized in table 2 in chapter 1 and appendix B of the DEIS.

In alternatives B–D, restoration would still occur and the number of acres treated would be the same. There would be no overall change in the effect to lands and minerals special uses.

Amendments Addressing Goshawks

This amendment would apply to both forest plans under all action alternatives. This amendment would not alter the acres treated for restoration activities and, therefore, would have no additional effects to lands and mineral special uses.

Amendment Addressing Garland Prairie Proposed Research Natural Area (RNA)

This amendment would apply to the Kaibab forest plan only. Under alternative C, it would add language to allow prescribed fire and mechanical treatments in order to maintain and/or restore the ecological qualities of the proposed RNA.

This amendment would have no long-term effect on lands and mineral special uses. There could be short-term, temporary impacts as site-specific restoration activities were implemented under alternative C. Project-specific mitigations would minimize these effects. These short-term effects and mitigations are described above in “Effects Common to All Action Alternatives.”

Amendment Addressing Cultural Resources

This amendment would apply to the Coconino forest plan only. Under all action alternatives, it would delete the standard referring to a “no effect” determination and would add the words “or no adverse effect” to the remaining standard. Management would strive to achieve a “No effect” or “no adverse effect” determination.

This amendment would have no additional effect on lands and mineral special uses, as authorization of such uses already requires archaeological and cultural screening.

Cumulative Effects

Actions considered in determining cumulative environmental effects are those known or anticipated to occur within the project area over the next 10 to 15 years. The cumulative effects analysis area is the same as the project area.

Appendix F of the DEIS lists all past, present, and future projects that may have a cumulative effect on the current project. Projects pertinent to lands and lands special uses were extracted into a separate document for this analysis (see appendix A of the lands specialist report).

The Forest Service has completed 270,894 acres of vegetation and prescribed fire treatments. Approximately 32,345 additional acres have been treated by permit holders as part of routine maintenance around authorized facilities (SUDS record search, April 2012). These actions have indirectly reduced the risk of fire to infrastructure authorized by lands special use permits and minerals permits.

Appendix A of the specialist report lists several ongoing and future fuels treatment projects within the project area, which are summarized in table 88. Under all alternatives, these actions would continue, as well as the routine clearing done by permit holders. These projects would contribute to forest health and restoration of the forest to its natural vegetative structure, which would, in turn, contribute to the reduction of fires that could produce severe effects to lands special uses and minerals (such as damaging or destroying infrastructure).

Table 88. Past, present, and future Forest Service actions with vegetation and/or fuels treatments within the project area

Project Type	Acres Treated (Prescribed Fire and Vegetation Treatments)
Past (2000–2010)	270,894
Current/Ongoing	178,717
Reasonably Foreseeable (Future)	229,640
Private/State/Other non-NFS lands	37,634
Lands Special Uses – Routine Maintenance	32,345
Total	**749, 230**

Alternative A

Permit holders would continue to conduct routine vegetation clearing on 32,345 acres as part of routine facilities maintenance, and 716,885 acres would be treated in planned fuels projects. Fire risk would be reduced on a total of 749,230 acres. Forest health would not be increased and the risk of wildland fires of high intensity would not be reduced. There would be no measurable cumulative effects to special use site access.

Alternatives B, C, and D

Under alternatives B, C, and D, the number of treated acres would be nearly doubled, to over 1.3 million (table 89). This would double the number of acres with reduced risk of wildfire. Overall forest health would be improved and the risk of severe wildland fires that could endanger lands special use and mineral sites would be reduced.

Table 89. Combined acres treated under current project and past, present, and foreseeable projects

Alternative	Acres Treated Under This Project	Total Treated Acres in Project Area
A	0	749, 230
B	587,923	1,337,153
C	593,211	1,342,441
D	556,279	1,305,509

Scenery

A summary of the scenery report is presented here. The specialist report (Minor 2013) is incorporated by reference.

Currently the scenery resources of Coconino NF are managed through application of the visual management system (VMS). The VMS was used to develop visual quality objectives (VQOs) that are prescribed in the forest plan for all lands within the Coconino NF. The VQO classifications range from preservation, retention, partial retention, modification, to maximum modification. The

VMS process has been updated in the scenery management system (SMS), which has been incorporated into the Kaibab NF forest plan via amendment 6 for the Williams and Tusayan Ranger Districts (USDA 2010).

This analysis evaluates the following questions in order to respond to/meet forest plan direction (questions 1 through 3) and key issues from scoping/public involvement (question 4 through 5):

1. To what degree would the proposed restoration activities affect the scenic integrity of the treatment area? (Measure: acres not meeting scenery integrity objectives (SIO).)
2. Would visual disturbances detract from the natural appearance or be outside of the historic range of variability? (Measure: qualitative description of anticipated disturbances.)
3. Would the proposed restoration activities sustain the valued scenic character and its scenery attributes through time? (Measure: acres meeting scenic character and scenery attributes.)
4. In what ways would prescribed fire smoke affect scenery? (Measure: qualitative description.)
5. Are large, mature trees retained as part of the scenic character? (Measure: Percent of old growth allocation in ponderosa pine and pinyon-juniper.)

A summary of the analysis completed for scenic resources is presented here. Please refer to the specialist report for methodology, data, and supporting information.

Affected Environment

The 4FRI project area encompasses the Arizona communities of Flagstaff, Mountainaire, Munds Park, Kachina Village, Mormon Lake, Doney Park, Parks, Williams, and Tusayan. Major access routes include Interstates 40 and 17, U.S. Highways 89, 180, and 66, State Route 64, County Road 73, and Lake Mary Road (Forest Highway 3). These communities and routes receive high use and users have high concern for scenery.

The treatment area’s dominant scenic identity is the continuous ponderosa pine forest, interspersed with grasslands, meadows, or sagebrush that overlays the undulating volcanic and sedimentary landforms. The treatment area is viewed at foreground, middle ground, and background distances from sensitive roadways, trails, and recreation sites located within and around the boundary.

Historic conditions better match scenic preferences for large, mature trees and forests with a more open structure (Ryan 2005), and current photos (see chapter 1 of the DEIS and figure 10 in the specialist report) are more representative of the higher density, continuous canopies, and similar ages classes found today. The vegetation is the dominant scenic attribute in the treatment area. There are substantial opportunities for improvement of the ecological function and for scenery attributes. The existing vegetation density and lack of high frequency, low-intensity fires are inconsistent with the desired scenic character and its sustainability:

- The dense conifer vegetation often obscures views of existing scenic attributes within the forest canopy and understory, and greatly restricts viewing access to potential scenic attributes.

- Intertree spaces and openings have been filled with small and medium sized trees, where if these were open, they would allow for sunlight to reach the forest floor adding to the scenic quality as well as helping provide for greater understory vegetation composition and abundance.
- Currently there is a risk of large scale, high-intensity fire that could result in elimination of the vegetation scenic attributes that are desired.
- Seeps, springs, and ephemeral drainages have had conifers encroach and overtop other species reducing their function over time. When these features are functioning properly, they provide high scenic quality and auditory, tactile, and visual features not found without the presence of water.
- Throughout the forest, unauthorized routes and redundant roads have been created. These detract from the scenic quality of the area by forming unnatural linear features that are uncharacteristic of the landscape. Decommissioning the routes and roads will restore characteristic features.

Scenery Attribute Risk Determination

Scenic stability uses a descriptive six level rating scale from very high stability to no stability to identify the degree to which the scenic attributes of the valued scenic character are likely to be perpetuated within the ecosystem. The highest scenic stability ratings indicate resilient ecosystems that are functioning within their reference conditions. Lower scenic stability ratings indicate areas where intensive vegetation management practices intended to restore ecosystem health and function could also benefit scenery by restoring and/or maintaining valued attributes of scenic character. Areas of higher scenic stability need less intensive management activities to maintain their valued scenic character attributes.

Scenery Attributes

- The ponderosa pine forest has an open appearance with tree groups of varying ages, sizes, and shapes and a mosaic of interspaces and openings. **This scenery attribute is at high risk.**
- Old age ponderosa pine trees are well represented across the treatment area. **This scenic attribute is at moderate risk.**
- The ponderosa pine and pinyon-juniper forests in the treatment area have a healthy, diverse understory. **This scenic attribute is at moderate risk**.
- The treatment area has a resilient forest where frequent, low-intensity fires occur without widespread crown fire or high-intensity surface fires. **This scenery attribute is at high risk.**
- Much of the forest has open appearance of tree groups and openings making the forest more resilient to mortality from insects and disease. **This scenery attribute is at moderate risk.**
- Within the ponderosa pine and pinyon-juniper forests, there is a healthy, resilient understory of trees and shrubs including Gambel oak, aspen, and sagebrush. Prairies and grasslands provide important contrast to the forested landscape**. The scenic attributes**

of Gambel oak, grasslands, and pine-sagebrush are a moderate risk, aspen is at high risk.

Minor Scenery Attribute

- Springs, seeps, and ephemeral channels are important scenery attributes because of the diversity they provide, including contrast in color, shape, and texture. In addition, the presence of water, even if seasonal, increases the valued scenery. **The scenic attributes of seeps, springs, and ephemeral channels are at moderate risk.**
- While roads provide important scenery viewing platforms, as well as access to the forest, scenic quality is improved by decommissioning some closed forest roads and unauthorized routes. **The scenery attributes of decommissioned roads are at moderate risk.**

Environmental Consequences

Alternative A – Direct and Indirect Effects

The treatment area would continue to be mostly natural appearing for several years. Important scenic attributes such as scattered groups of trees of all ages with grassy openings, evidence of frequent low-intensity fire, large mature tree character, diverse understory, prominent aspen, Gambel oak and grasslands, and functioning riparian systems and ephemeral channels that historically contributed to the attractiveness of the area would continue to decline.

Views into the project area from roads, trails, recreation sites, and residential areas would be further reduced due to the overstocked condition of the stands, and the grass/forb/shrub understory component would continue to decline in composition and decrease in abundance. Unauthorized routes and closed roads would not be decommissioned, and would continue to be visible linear features uncharacteristic in the landscape. If unauthorized routes and decommissioned roads were unused, they would naturalize in 10 to 20 years.

In the event of an uncharacteristic high-intensity wildfire such as the Schultz Fire (Coconino NF, 2010), the existing landscape character would be suddenly altered with little opportunity to slow or control the change. The landscape would be changed to such a degree that very few of the scenic objectives could be met in the short or long term. An uncharacteristic high-intensity, large-scale wildfire would redefine and reshape the existing landscape character for decades if not centuries. The appearance and character of the area would shift from densely forested to patchy and open. The overstory component and green canopy would be absent or drastically reduced, depending on the intensity of the fire. For a few decades, the landscape would be dominated by blackened, dead standing trees; if allowed to come down on their own, the trees would likely fall in a dense, jackstraw pattern. Although short term, smoke from high-intensity wildfire would cause scenic quality to be diminished and obscure views to scenic attributes. Emergency fire suppression would result in short-term impacts (see specialist report for details).

A vegetation type change could occur especially if there is widespread drought and/or if trends toward higher temperatures and less annual precipitation continue. These changes would be visible throughout the treatment area in the foreground of forest roads and trails, and as middle ground and background views from communities and developed recreation sites. There would be long-term (more than 20 years) impacts to major landscape attributes such as ponderosa pine forests with large, mature trees.

This alternative would not meet the project desired conditions or forest plan direction. It would not move the treatment area toward scenic stability. Over time, scenic stability would decrease and move to very low. No action would result in continuation of current risks to scenic attributes and it is reasonable to assume that these risks would increase each year and could be exacerbated by climate change. The alternative would not meet long term scenic integrity objectives since these are dependent upon improving the condition of scenic attributes so that they are more resilient to ecological stressors.

Cumulative Effects

The cumulative effects analysis area is the ponderosa pine forest on the Coconino and Kaibab NFs. The timeline for analysis is 20 to 30 years because most long-term effects of the alternatives are assessed out to a 20- to 30-year timeframe (with the exception of large-scale, high-intensity wildfire which is more difficult to project).

The cumulative effects of past management activities are visible as the existing conditions. Vegetation management practices, fire suppression, and overgrazing have resulted in the current even-aged forest structure, overstocked conditions, and sparse understory trees, shrubs, grasses, and forbs.

The short term cumulative effects (1 to 5 years) of the alternative combined with similar current and future restoration treatments and prescribed burning projects are expected to be negligible, unless additional large-scale, high-intensity wildfires occur in the ponderosa pine type. In the absence of large, high-intensity wildfires, long term cumulative effects of the alternative, present and future vegetation management, and prescribed burning projects would be small and localized. The desired landscape character of an open forest with tree groups of varying sizes, shapes, and ages, presence of large, mature trees, and healthy, diverse understory would not be met. Other scenic effects could include bare ground from grazing and recreation use and unhealthy forest conditions resulting from disease and drought. These combined effects could result in a trend toward declining landscape attributes, and less sustainable landscape character.

If wildfires burn large areas, the scenic quality would be decreased, and there would be long-term negative changes (10 to 100 years) in scenic character. The scenic attributes that contribute to high scenic integrity—such as an open forest with tree groups of varying ages, sizes, and shapes, large, mature trees, and healthy, diverse understory—would not be present. The scenic impact of a high-intensity wildfire combined with scenic impacts from adjacent land development, powerline development and maintenance, and dispersed recreation use could result in a cumulative impact of greatly diminished scenic integrity in burned areas for up to a decade or more. In some places there would be a chance that climate change could contribute to type changes in parts of the ponderosa pine forest so that these characteristics would be replaced with difference landscape characteristics, which would also cumulatively impact scenic attributes.

Environmental Consequences Common to Alternatives B, C, and D

- There would be short-term effects to scenery from restoration treatments in aspen stands.

- Spring restoration includes removal of some vegetation and prescribed burning near the sites. There are minimal to low effects to SIO from these treatments. Effects would be similar to those described for mechanical treatment and prescribed fire, although at a much smaller scale.
- Channel treatments would have short-term effects (lasting 1 to 5 years) on scenic attributes. Bare soil would be exposed, rocks and logs moved, and some disturbance from vegetation restoration would be visible for a few years until the desired understory vegetation begins to fill in and reestablish. These activities would have low effects to SIO. Following treatment, these areas would be improved and would make progress toward desired conditions.
- All fencing actions (aspen, ephemeral channels) would introduce unnatural linear features into the landscape that would not be natural appearing. Since these are isolated areas scattered around the over 500,000-acre project area, introduction of linear features would have low effects. If the fences are maintained, wood fencing would have very low effects and would meet the SIO. If they fall into disrepair, this would detract from their appearance, but they would still meet the SIO. Wire fencing materials would be more noticeable than wooden fences. Wire and metal posts can be shiny and their color can contrast with the natural surroundings. Mitigation measures would be used to introduce the fewest contrasting elements where wire fencing is used, and effort would be made to site locate the fencing where it would be least noticeable. Wire fencing would have low effects and would meet the SIO.
- Placement of jackstraw treatment would not meet the requirements for foregrounds of high concern level roads in high SIO areas. Even if these sites were allowed to drop one SIO level, they would still not meet the basic definition of moderate SIO that "noticeable deviations must remain visually subordinate to the landscape character being viewed" (USDA 2000).
- Beyond the foreground 300 feet, jackstraw piling may be suitable and would be mitigated by carefully locating piles. These areas would drop to moderate SIO for 10 to 20 years. As jackstraw barrier begins to deteriorate, trees lose their brown needles, branches break off, and logs lose their bark and grey out, the jackstraw piles compress and become less noticeable. It is anticipated that the aspen would be large enough to withstand ungulate browsing by the time the jackstraw piles have deteriorated or burned in followup prescribed fire activities. These areas would improve over time to the mapped SIO.
- Potential effects from road reconstruction include exposure of bare soil, tree stumps, and contrasting color and texture of surfacing materials. These effects would usually be short term (1 to 5 years) and become less noticeable as natural vegetation is reestablished and the surfacing material begins to be incorporated into the soil horizon.
- The construction of new roads would add new, unnatural linear features into the landscape on a temporary basis. Trees would be removed, soil exposed, and roadbeds constructed including minimal drainage features. This would have moderate effects on the mapped SIO. In high SIO (about 50 percent of the area), the new road construction would drop these areas one level to moderate until the roads are decommissioned and begin to naturalize, about 5 years later. Mitigation measures and BMPs would hasten

recovery. The new temporary roads would naturalize over time and become less noticeable to the casual observer.

- There would be short-term effects (up to 5 years) from road decommissioning as the roads have drainage established, are roughened, seeded, and mulched with pine needles and small slash. Mitigation measures and BMPs would be used. The existing closed roads would naturalize over time and become unnoticeable to the casual observer.
- Hand thinning usually has little or no short-term effects on scenery. Trees are cut down and then cut into segments that can be treated. Effects may include slash from limbing and topping trees. Project mitigations require slash to be treated.

Alternative B – Direct and Indirect Effects

There would be a low to moderate effect on scenic quality during and immediately following mechanical treatment methods. The presence of skid trails, landings, and piled or scattered slash would also result in a moderate reduction of the scenic quality until harvesting activities are completed and mitigation measures are implemented. The effects in these areas would be short term (lasting 1 to 5 years after treatment) since skid trails would be rehabilitated and activity generated slash would be treated or mostly removed to be utilized. The ground disturbance resulting from using machines to pile slash would be noticeable for 1 to 3 years after project completion, depending on how quickly the areas revegetate. Scraped trees would heal or scars would become less noticeable over time.

Where utility corridors cross the restoration area, proposed mechanical treatments adjacent to the corridors will help to improve the scenic quality. Mitigation measures have been developed to feather treatments or increase their intensity close to the corridors. This will have the effect of reducing the contrast between the cleared corridors and dense stands adjacent to them.

Effects from pile burning would be primarily limited to the immediate dead and live fuels of the slash pile, although some scorching and mortality of residual trees would be expected. Smoke from pile burning would be dense when the piles are ignited and as they burn, but would be short term in most cases.

Prescribed fire would likely result in short term, moderate reduction in scenic quality. The presence of charred surface vegetation and red or black trees would present a contrast to the otherwise green surroundings. These contrasts would soften and become less noticeable within two or three growing seasons after project completion as the understory component (grass, aspen, and oak seedlings, etc.) moved in, as singed trees either recovered or die, and as dead standing trees fell down. Smoke from prescribed fire would be heaviest during the initial burns and would reduce visibility of the scenic landscape in the short term. Some residual smoke could be expected to continue in small localized areas where stumps or roots smolder for up to a few weeks. The residual smoke would have little, if any, effect on visibility of scenic attributes.

Effects may last longer and be more pronounced in areas of moderate to high fire intensity. In these locations, standing dead trees may be present for a decade or more until they fall down. Understory vegetation would take some time to recover but is expected to look more natural appearing within 5 years. Since it is expected that this would be produced over no more than 10 percent of the treatment area, effects would be localized and limited.

Repeat burning would result in fewer effects than described above since fuel loadings would be reduced by initial prescribed burns. Effects are expected to be noticeable for a shorter duration, and within 2 to 3 years, the areas will be natural appearing. Smoke from repeat burning would not be as heavy as initial burns and would be expected to be shorter in duration.

When the treatments are all completed, it is expected that many of the ecological stressors would be lessened, and the scenic stability would move from low to high on 589,923 acres within the restoration area. The proposed treatments and prescribed burning would make progress toward desired conditions and would improve forest health and resilience. The treatments would increase scenic stability for large, mature trees. The treated areas would have more of the desired landscape characteristics and would make progress toward meeting SIO. The 4FRI project would help achieve the desired conditions for scenery as defined in the forest plans.

Forest Plan Amendments

Coconino NF

Three nonsignificant forest plan amendments (for more details refer to appendix B of the 4FRI DEIS) would be required on the Coconino NF to implement the proposed action:

- **Amendment 1**: The effects of this amendment would be to move vegetation in these areas slightly closer to restored conditions. They would slightly improve scenic stability in MSO PACs, but these areas would still be at risk for disturbances such as high-severity wildfire or large scale insect and disease outbreaks.
- **Amendment 2** would move vegetation closer to desired conditions, improve scenic stability, and overall scenic integrity. It would result in improved forest structure and pattern, forest health, and vegetation composition and diversity, and overall forest resiliency, all of which would relate directly to decreased risks to scenery from natural disturbances.
- **Amendment 3** would have no effect on scenery.

Kaibab NF

Two nonsignificant forest plan amendments (see appendix B) would be required on the Kaibab NF to implement the proposed action:

- **Amendment 1** would move vegetation closer to desired conditions, improve scenic stability, and overall scenic integrity. It would result in improved forest structure and pattern, forest health, and vegetation composition and diversity, and overall forest resiliency, all of which would relate directly to decreased risks to scenery from natural disturbances.
- **Amendment 2** would defer all MSO monitoring to the project’s FWS biological opinion. This amendment would have no effects on scenery.

Cumulative Effects

The short term cumulative effects (1 to 5 years) of alternative B combined with similar current and future restoration treatments and prescribed burning projects are expected to be widespread. There would be evidence of restoration treatments, and the scenic quality would be decreased in some places in most of the ponderosa pine on the Coconino and Kaibab NFs. For example, in areas where restoration treatments result in skid trails or removal of vegetation for staging areas or log decks, there could be a cumulative impact to scenic attributes where activities such as dispersed recreational use, grazing, or adjunct private land or infrastructure development is also occurring. In general, these cumulative impacts to scenic attributes would be localized in scale (1 to 10 acres) and would most likely be of short-term duration (1 to 5 years).

In the long term (5 to 20 or 30 years), there would be large and widespread improvement in the health and sustainability of scenic attributes that make up the landscape character of the ponderosa pine forest. Forest users would experience an open forest with tree groups of varying ages, sizes, and shapes, large, mature trees, and healthy, diverse understory. In many places, the scenic integrity objectives would be met.

When natural stressors such as wildfires or insect outbreaks occur, or human activities such as new utility corridors, a new recreation site, or a new private subdivision are developed, the cumulative effects of alternative B and other projects would result in small and localized changes in the scenic character of the ponderosa pine forest. When drought conditions or unusual weather events as a result of climate change occur, the ponderosa pine forest would be healthier and more resilient to such events, thus counteracting the effects of climate change which are likely to detract from scenic attributes. The overall trend from this alternative would be toward improving landscape attributes and sustainable landscape character.

Alternative C – Direct and Indirect Effects

Effects would be similar to alternative B. About 10 percent more acres would be mechanically treated and about 1 percent more acres burned than alternative B. Alternative C would improve understory species abundance and composition slightly more than alternative B since the combined thinning and prescribed fire has been found to be a more effective tool (Laughlin et al. 2008). This alternative would result in slightly better understory response and slightly more large trees, which would better meet scenic objectives.

This alternative adds construction of up to 15 weirs and 20 weather stations (3 acres of disturbance) to support watershed research. The construction of these features would create contrast with the characteristic natural landscape. Mitigation measures would assure the weirs are constructed of natural appearing materials and are of a shape and form that does not create too much contrast. This would help blend with the surrounding landscape. A weather station located outside of the immediate foreground (300 feet) would use nonreflective surfaces, and careful siting would help these features blend with the surrounding landscape.

Forest Plan Amendments

Coconino NF

Three nonsignificant forest plan amendments (see appendix B) would be required on the Coconino NF to implement alternative C:

- **Amendment 1:** This alternative would increase the size of trees that could be removed in 18 MSO PACs and allow use of low intensity prescribed fire within 56 PAC core areas. Old, large diameter trees are an important part of the scenic quality. There may a slight decrease in scenic quality as a result of removing larger diameter trees, but it would also result in slightly greater reduction of tree density in these areas which is important for scenic stability. Of these areas, 56 would also receive low intensity prescribed burns. While there would be short-term effects from tree removal and burning, there would be slightly higher improvement in overall scenic stability than with alternative B or D. The amendment would allow for more treatments which would open up these PACs more, creating the potential for views beyond the immediate foreground. This would have a somewhat greater positive effect on scenic quality than action alternative B or D.

- **Amendment 2:** The effects to scenery would be the same as with the alternative B Coconino NF forest plan amendment 2.
- **Amendment 3:** There would be no effects to scenery from this amendment.

Kaibab NF

Three nonsignificant forest plan amendments (see appendix B in the 4FRI DEIS for details) would be required on the Kaibab NF to implement alternative C:

- **Amendment 1:** The effects of this alternative would be the same as for alternative B Kaibab NF forest plan amendment 2.
- **Amendment 2:** There would be a short-term (1 to 5 years) decrease in scenic quality from mechanically treating and prescribed burning Garland Prairie RNA. (The details of effects from mechanical thinning and prescribed fire are found under alternative B.) Those effects would be similar to those described earlier in this chapter. In the long term, these treatments would result in improved plant vigor and species diversity (Noble 2013), which would be positive for scenic drivers, hikers, equestrians, and others. There would be an improvement in the scenic stability and scenic integrity for this area with this amendment.
- **Amendment 3** would have no effects on scenery.

Cumulative Effects

The cumulative effects would be similar to alternative B. There would be slightly more negative short term cumulative effects in localized areas (those with skid trails, pile burns, and staging areas) since this alternative would mechanically treat and burn about 10 percent more acres, and prescribed burn about 1 percent more acres. However, there would also be slightly more positive long term cumulative effects from counteracting drought and insect damage likely to occur as a result of climate change since there would be more mechanical treatment and burning to facilitate greater forest resiliency.

Alternative D – Direct and Indirect Effects

The short term (1 to 5 years) visual disturbances from restoration activities would be within the reference conditions of the area. In the short term (1 to 5 years), the disturbances would be visible and would lower the scenic quality. In about one-third of the area where both thinning and prescribed fire occur, the results would be similar to those found with alternative B. In the remainder of the restoration area only receiving mechanical treatments, the natural appearance of the area would begin to recover, but over time, these improvements would become static and begin to deteriorate again. Throughout project implementation, it is expected that the valued scenic character would begin to improve, but the risks to scenic attributes would only improve in the short term (1 to 5 years), and the risk of high-intensity fire would begin to increase in the landscape. In addition, if a wildfire were to start, it is likely that while it would be mostly a surface fire, it might be moderate and high intensity, and many trees would be scorched and killed as a result, thus reducing scenic quality. This alternative would result in about one-third as much understory vegetation improvement than with alternative B or C.

Forest Plan Amendments

The effect of forest plan amendments is the same as described for alternative B.

Cumulative Effects

The short term cumulative effects (1 to 5 years) of alternative D combined with similar current and future restoration treatments and prescribed burning projects are expected to be widespread, but of small scale (1 to 10 acres) where they occur. For example, in areas where there would be evidence of mechanical thinning treatments, together with evidence of grazing and dispersed recreation impacts or infrastructure development (utility lines), the scenic quality would be cumulatively decreased in these places.

In the long term (5 to 20 or 30 years), initially there would be widespread improvement in forest structure, but vulnerability to wildfire would remain high, thus limiting forest resiliency. While this alternative would counteract impacts to large trees and understory vegetation resulting from climate change and the resulting drought and vulnerability to insect outbreaks and disease, it would be very limited. Specifically, the understory would not be as healthy or diverse, and understory vegetation would continue to be cumulatively impacted by grazing, recreational use, and abiotic factors such as drought.

When natural stressors such as wildfires or insect outbreaks occur, or human activities such as new utility corridors, a new recreation site, or a new private subdivision are developed, the effects of alternative D could serve to slightly counteract the scenic effects of these activities and other projects, but it would be limited compared to other alternatives. When drought conditions or unusual weather events as a result of climate change occur, the ponderosa pine forest would not be as resilient to such events. The overall trend to scenic quality resulting from this alternative in combination with other activities and projects would be toward level or downward for improving landscape attributes and sustainable landscape character.

Range

A summary from the range specialist report is presented here and the complete report is incorporated by reference (Hannemann 2013). Refer to the specialist report for additional information that includes: methodology, the grazing history of the project area, and supporting information. This analysis incorporates questions designed to evaluate movement toward desired conditions and concerns brought up by the public during scoping: (1) How would project activities affect livestock grazing management in the project area? (2) How would project activities affect livestock forage in the project area? (3) Would livestock grazing affect the restoration of understory species? (4) How would livestock grazing affect the ability to return fire as a natural process to the project area? and (5) How would climate change affect the range resource and how would the project affect climate change (relative to range)?

Affected Environment

The affected environment for the range analysis is the project area. Only allotments within the project area have been considered. Within the project area, approximately 791,250 acres are within grazing allotments and 197,779 acres are not grazed by livestock. The amount of each allotment lying within the project area averages 65 percent and varies between 0.002 to 100 percent.

There are 49 livestock grazing allotments of which 47 are active allotments and 2 are vacant (see the specialist report for figures displaying allotments within the project area). Of the 49 allotments, 40 permit cattle grazing and 9 permit sheep grazing.

There are 229 main pastures located within the project area. Main pastures are the large pastures that are used more than 20 days per year by livestock. Total allotment acres and acres by RU can be found in the specialist report in table 2. Restoration units were used for display purposes only and were not used in the analysis. See the specialist report for details on allotment grazing management systems, current numbers of permitted livestock, and seasons of use within the project area.

A study was conducted in 2011 on the trends of understory vegetation within the project area (Brewer 2011). Currently the range has seen a shift to warm season species dominance in many areas of northern Arizona as a result of relative lower winter moisture and higher summer moisture. The warm season plant that has benefited most from this shift is blue grama. Because blue grama is a dense mat forming species, many areas have seen an increase in perennial plant cover and ground cover. The trends of forage production during this time period have been static.

Environmental Consequences

The environmental consequences for alternatives B, C, and D are based on the application of resource protection measures and are based on the environmental consequences in the silviculture, fire, and wildlife (herbaceous understory analysis) reports. See the “Range” section in appendix C of the DEIS for the complete list of resource protection measures.

Alternative A – Direct and Indirect Effects

The expected reduction in understory vegetation would reduce the amount of forage available to livestock. Over time, livestock numbers would be reduced. A reduction in forage followed by a decrease in livestock numbers has been recorded through the last 100 years throughout the project area. There is no reason to believe that this trend would not continue under alternative A. Uncharacteristic wildfire would have an adverse impact on livestock grazing management and forage until the area recovers and structural improvements are replaced.

All Alternatives – Direct and Indirect Effects

- Mechanical treatment and prescribed burning would increase understory vegetation. Understory species and composition would change primarily by increasing shade intolerant understory species and decreasing shade tolerant species. The increase in forage would have a short term (within 3 years) and long term (10-year) beneficial effect to livestock grazing.

- Spring exclosure areas would not be available for livestock grazing and would have an adverse impact on available forage within a pasture. However, these exclosures would not be large enough and would not amass in any particular pasture to reduce pasture stocking rates. In addition, by the time these exclosures would be completed, it is anticipated the increase in pasture forage by tree thinning and burning would help to offset the forage lost within the exclosures. Spring projects would not have a measureable impact on the capacity of allotment or grazing management.
- The ephemeral drainage improvements would have a benefit to livestock grazing management by increasing forage by improving bank stability and decreasing the amount of sediment to downstream stock tanks.
- Aspen exclosure areas would not be available for livestock grazing and would have an adverse impact on available forage within a pasture. However, the majority of these exclosures would not be large enough or amassed in any particular pasture to reduce pasture stocking rates. Aspen projects would not have a measureable impact on the capacity of allotment or grazing management.
- Road and route decommissioning would have a beneficial effect to livestock grazing by growing additional forage in the old roadbed. Constructing temporary roads would have a temporary adverse effect to livestock grazing when the forage on the road was disturbed. Road reconstruction would have no effect on livestock grazing. No road project would have a measureable impact on the capacity of allotment or grazing management.
- There are no long term, unavoidable adverse effects in alternatives B–D related to livestock grazing because effects would be short term in nature and wouldn’t affect grazing permit capacity. There would also be no irreversible and irretrievable commitments of resources because forage would grow back in the next growing season after treatments or after managed grazing. Alternatives B, C, and D would be in compliance with the Coconino and Kaibab National Forest plans for livestock grazing.

Alternative B – Direct and Indirect Effects

Alternative B would affect all grazing allotments within the project area and 184 main summer pastures with mechanical and prescribed fire treatments. Ten pastures would be affected by prescribed fire-only treatments. Mechanical treatments by allotment would vary from 0 to 35,658 acres. See the specialist report for detailed information on acres affected by allotment. Prescribed fire only treatments by allotment would vary from 0 to 19,458 acres. Mechanical and prescribed fire treatments would have a benefit to livestock grazing management by an increase in forage (also see effects common to all action alternatives). Treating up to two pastures per year per allotment would have an adverse effect to livestock grazing management and forage until the burn area shows range readiness (see “Effects Common to All Action Alternatives”).

The alternative would reduce the risk of fire burning with high severity through multiple pastures, burning fences and other structural range improvements, and adversely affecting livestock management.

Alternative C – Direct and Indirect Effects

Alternative C would affect 192 main summer pastures with mechanical and prescribed fire treatments. Two pastures would be affected by burning only treatments. Table 7 in the specialist report displays the total acres of vegetation and prescribed fire treatments within each allotment. Thinning treatments by allotment vary from 0 to 36,895 acres. Prescribed fire only treatments by allotment vary from 0 to 17,939 acres. Mechanical and prescribed fire treatments would have a benefit to livestock grazing management by an increase in forage. Up to two pastures per year per allotment would have an adverse effect to livestock grazing management and forage until the burn area shows range readiness (“Effects Common to All Action Alternatives”).

Alternative C reduces the risk of uncharacteristic wildfire through thinning 434,189 acres and burning 593,473 acres within the project area over the next 10 years. These treatments would reduce heavy fuel loading, break up the tree canopy, raise the tree canopy, and burn fine ground fuels (Lata 2013). These actions reduce the risk of uncharacteristic wildfires that can burn with high severity through multiple pastures, burning fences and other structural range improvements, and adversely affecting livestock management.

Alternative D – Direct and Indirect Effects

Alternative D would affect 184 main summer pastures with mechanical and prescribed fire treatments. Ten pastures would be affected by prescribed fire only treatments. Nine pastures that have mechanical treatments would not have prescribed fire. Mechanical treatments by allotment would vary from 0 to 35,658 acres. Prescribed fire only treatments by allotment would vary from 0 to 18,799 acres. Mechanical and prescribed fire treatments would benefit livestock grazing management by increasing forage. Up to two pastures per year per allotment would have an adverse effect to livestock grazing management and forage until the burn area shows range readiness. The nine pastures that do not have prescribed fire would not need to be rested from livestock grazing. However, the pastures would not have the added benefit of increased forage that prescribed fire provides.

The alternative would reduce the risk of fire burning with high severity through multiple pastures, burning fences and other structural range improvements, and adversely affecting livestock management.

Forest Plan Amendments

Alternative B and D

Coconino NF

Amendment 1: The amendment would affect grazing in that it would increase forage which would benefit livestock grazing. According to the fire analysis (Lata 2013), the amendment would result in a slight decrease in crown fire potential for the 18 MSO PACs that would receive mechanical treatments. If amendment 1 is not implemented on the Coconino NF, these 18 PACs (approximately 10,700 acres) would retain the current forest structure that places them at high risk of high-severity fire. If prescribed fires were implemented on acres adjacent to PACs, it is more likely that some fire lines would need to be created to avoid burning in the PAC, producing ground disturbance that would be less likely under the proposed amendment. Ground disturbance would result in short-term reduction in forage for authorized livestock. The monitoring portion of the amendment would not affect grazing management.

Amendment 2 would allow 29,017 acres to be managed for an open reference condition. There would be increased understory vegetation which benefits grazing management. According to the fire analysis (Lata 2013), an indirect effect of this amendment would be a reduced potential for active crown fire which would benefit grazing. If amendment 2 were not implemented, it is likely that another type of restoration treatment would have been developed which would reduce the risk of severe fire behavior and improve forest structure, forest heath, and understory productivity. Restoration actions in general would benefit grazing management. The canopy cover portion of the amendment would have no effect on grazing management.

Amendment 3 would have no effect on grazing management.

Kaibab NF

Amendment 1 would allow over 27,000 acres to be managed for an open reference condition. There would be increased understory vegetation which would benefit grazing management. According to the fire analysis (Lata 2013), an indirect effect would be a reduced potential for active crown fire which would benefit grazing. If amendment 2 were not implemented, it is likely that another type of restoration treatment would have been developed which would reduce the risk of severe fire behavior and improve forest structure, forest heath, and understory productivity. Restoration actions in general would benefit grazing management. The canopy cover portion of the amendment would have no effect on grazing management.

Amendment 2 defers all MSO monitoring to the project's FWS biological opinion. Based on past experience with other projects, this would not be likely to affect grazing management.

Alternative C

Coconino NF

Amendment 1: The effects (benefits) of implementing amendment 1 in MSO habitat is the same as described for alternative B. In alternative C, additional acres of MSO habitat would receive prescribed fire which would further benefit grazing management.

Amendment 2: The effects of implementing amendment 2 would be the same as described for alternative B.

Amendment 3 would have no effect on grazing management.

Kaibab NF

Amendment 1: If amendment 1 was implemented, the same effects that are described above for alternative B would apply to 27,765 acres that would be managed for an open reference condition.

Amendment 2: Amendment 2 would have no effect on grazing management. Grazing is currently excluded from the proposed RNA.

Amendment 3: If amendment 3 (MSO habitat management on the Kaibab NF) was implemented (or not implemented), the effects would be minimal to grazing management. Grazing authorizations would continue to comply with the forest plan requirements that apply to grazing in MSO habitat.

Cumulative Effects – All Alternatives

The spatial area considered for cumulative effects analysis includes 100 percent of the acres within allotments that occur within the project area. This is a logical boundary because changes to grazing management in one pasture of an allotment affect the management in the entire allotment. The project area occupies an average of 65 percent of each allotment that the project area intersects, with several being wholly within the project area and the minimum occupancy of a single allotment being less that .01 percent.

The timeframe for these combined effects is 10 years because changes in condition and trend in the vegetation depend on the presence of favorable growing conditions after cattle leave the pasture. If growing conditions are favorable, plant height and canopy cover would completely recover from the impacts of the proposed forest management activities within 1 year. If growing conditions are not favorable, plant recovery would occur more slowly (up to 2 to 3 years). Vegetation recovery from the other activities and natural events may take this long depending on annual weather conditions, particularly annual precipitation.

Cumulative Effects Baseline

The baseline includes the vegetation and prescribed fire projects from 2001 to 2010 including 140,614 acres of mechanical thinning and 119,751 acres of prescribed fire within the project boundary, most on the same locations. The baseline also includes the use of up-to-date grazing systems and adaptive management on all the allotment acres of the cumulative effects area, and the use of over 20 livestock/elk exclusions to protect aspen and over 15 exclosures to protect riparian areas.

Past restoration projects (see specialist report, cumulative list of projects) within the project area have increased forage and understory vegetation. Forest Service policy has changed over time and the forests are now allowed to be managed for uneven-aged tree management and to allow fire to return to its nature role in the ecosystem. Current grazing management conducted utilizing adaptive management procedures in order to meet objectives established in existing allotment management plans is also part of the existing baseline.

Areas included with the cumulative effects analysis area, external to National Forest System lands, are primarily lands under private ownership and lands under the jurisdiction of the State of Arizona and National Park Service. Grazing on adjacent forest land is grazed very similarly to grazing within the project area. Livestock grazing occurs in the majority of these areas except within Walnut Canyon National Monument. Private lands within communities are not typically utilized by livestock with the exception of horses. Private lands outside of communities typically provide forage for livestock consisting mostly of small livestock operations, but can provide for larger livestock operations when the private land is in larger blocks. State lands are also utilized by livestock with many of these State lands managed in conjunction with Forest Service allotments. There are no indications that livestock use within these areas is going to change dramatically during the next 10 years. In addition, these lands are not large enough that livestock use could be moved to these areas to offset the effects of the proposed treatments.

Livestock Grazing Management and Livestock Forage

The cumulative effect to livestock grazing management and livestock forage for alternative A is no change in the short term but a long-term decrease in forage with an increase in trees. Within the cumulative effects boundary, 588,182 acres related to the 4FRI project boundary would not be treated and would have no change in the short term, but there would be a long-term decrease in forage with an increase in trees. When other current and foreseeable projects are considered, an additional 146,891 acres will be treated (31,492 mechanical thinning and prescribed fire, 49,466 acres of thinning only, and 65,933 acres of prescribed fire only) and affect 15 percent of the allotment acres. Livestock grazing management would be affected by these treatments the same as the other alternatives. Pastures would be rested and deferred as these treatments are completed. With less treatment acres, pasture rotations will be less affected.

The alternatives B, C, and D proposed treatments and the other current/foreseeable projects generally overlap in time and space (see cumulative effects description in appendix F). When the 4FRI acres are combined with vegetation and prescribed fire projects, 74 percent of the cumulative effects boundary (89 percent of all allotments) would have reduced forage. However, this would be a short-term effect with a typical duration of 1 year after burning.

In the long term, forage would increase on these same acres in the cumulative effects boundary. In terms of grazing management, even though 705,695 acres have reduced forage for a period of 1 year, this would not affect grazing management because mitigation restrictions would apply to all planned and ongoing projects. No more than one main pasture per allotment would be burned per year on the majority of the allotments, and this would not add to the grazing management effects because these mitigation restrictions also apply to these ongoing projects.

Livestock Grazing Impacts to Fire

The cumulative effect of livestock grazing on meeting the objective of restoring fire to the landscape for alternative A would not change because of the minimal and managed direct or indirect effect of current grazing (see effects analysis). The same would be true for alternatives B, C, and D, with minimal and managed direct and indirect effects of livestock management with the proposed treatments (see effects analysis). The ability to meet fire objectives in alternatives B, C, and D when considered with ongoing and foreseeable projects that includes 65,933 acres of prescribed fire (see cumulative effects report) would not be affected due to current grazing management strategies that are in place and the use of adaptive management.

Livestock Grazing Impacts to Understory

The cumulative effect of livestock grazing to achieving increased understory response for alternative A would not change because of the minimal and managed direct or indirect effect of current grazing (see effects analysis). The same would be true for alternatives B, C, and D, with minimal and managed direct and indirect effects of livestock management with these proposed treatments. The ability to achieve increased understory response in alternatives B, C, and D when considered with ongoing and foreseeable projects that includes 31,492 mechanical thinning and prescribed fire, 49,466 acres of thinning only, and 65,933 acres of prescribed fire only treatments (see cumulative effects report) would not be affected due to current grazing management strategies in place and the use of adaptive management. Livestock grazing would adapt to changes in forage conditions through time.

Transportation

A summary of the transportation report is presented here. The specialist report (Fleishman 2013) is incorporated by reference.

Currently, there are approximately 4,278 miles of roads within the analysis area that are managed under Forest Service jurisdiction. Of this total, approximately 3,334 miles are open roads and 944 miles are closed roads. In addition to the roads that are currently managed by the Forest Service, there are approximately 374 miles of additional unauthorized roads that have been identified within the analysis area, for a total of approximately 4,652 miles of roads on Forest Service lands within the project area. See the specialist report for details on miles (and locations) of road by operational maintenance level (1 through 5).

Not all of the 4,278 miles of road within the 990,000-acre analysis area would be needed for removal of forest products. A haul route analysis identified approximately 2,297 miles of existing road necessary for removal of forest products after harvest.

Environmental Consequences

The analysis focuses on two items related to the purpose and need of the project:

- How access to the project area is met by alternative in order to implement the project. The unit of measure is miles of system road and miles of temporary road.
- How each alternative moves toward a safe and more affordable transportation system that is identified within each forests respective travel analysis project (TAP) documents. The unit of measure is miles of decommissioned roads, miles of open road for a more affordable road system, and miles of road maintenance for road safety.

The timeframe for the analysis is the life of the project (about10 to 15 years).

Alternative A

Direct and Indirect Effects

Under alternative A, current road management would continue on the two forests, including maintenance of the open road system. The current transportation system would be adequate to access the project area as defined in each forest’s respective travel management decisions in both the short term (current to 10 years) and long term (greater than 10 years from current). No harvest activities would occur and no new temporary roads would need to be constructed.

Additional NEPA analyses would be necessary to carry out on-the-ground closure activities identified in the TAPs. Therefore, this alternative does not move toward a safe and more affordable road system. Road maintenance would continue, primarily on maintenance level 3 through 5 roads, as well as a limited basis on level 2 roads.

Cumulative Effects

There are no actions proposed from this alternative, hence there are no cumulative effects.

Alternatives B, C, and D

Assumptions used to evaluate environmental consequences include the following:

- Maintenance of open existing roads may include road maintenance activities described in the Forest Service Operations and Maintenance Handbook (FSH 7709.59) such as, but not limited to, road blading, draining maintenance, culvert installation, culvert replacement, spot surfacing and resurfacing, removal of slides and slumps, removal of danger trees, removal of roadside vegetation for improved site distance on the roads, dust abatement, removal of overhanging vegetation to allow for access, and installation of signs. This activity would be expected to occur on approximately 2,297 miles of road. Dust abatement would be expected to occur on about 7 miles of road.
- Road reconstruction would include road improvement activities on about 30 miles of roads and road relocation on about 10 miles of roads.
- Road improvement activities are defined as activities that result in an increase of an existing road's traffic service level, expansion of its capacity, or a change in its original design function. Road improvement activities would include, but are not limited to, widening corners to improve turn radiuses, straightening of road segments to improve haul safety, installing turnouts to improve haul safety, and changing alignments at road intersections to improve site distance and haul safety. These activities may result in limited removal of vegetation. These activities would occur on approximately 30 miles of roads within the project area.
- Road relocation in the vicinity of ephemeral, intermittent, and perennial streams would be designed to lessen the impact on these waters. Road reconstruction may include relocating roads out of drainages, construction of rock rip-rap, installation of new culverts, and construction of low water crossings. Up to 10 miles of road within the project area would have this road treatment. The desired condition for stream road segments is to have ephemeral, intermittent, and perennial watercourses slow the speed of waterflow, have access to the flood plain, transport sediment, and maintain longer sustained base flows on the landscape, rather than a flush of peak flows. Flood plains would function to lessen the impacts of floods on human safety and health.
- Temporary roads that are necessary for treatment purposes would be used during project implementation to provide for access to the area to implement the proposed activities (see alternative descriptions for road related activities and miles).
- Once treatment has occurred, temporary roads would be decommissioned. Unneeded, closed (ML 1) roads would be decommissioned as needed and returned to a more natural state. Decommissioning of system roads and unauthorized routes would use an adaptive management framework outlined in the specialist report (see specialist report, appendix A) and would also utilize design features outlined in the soil and water specialist report. This would occur on approximately 517 miles of temporary roads within the analysis area and on approximately 42 miles of system roads within the analysis area.

Direct and Indirect Effects

The 2,297 miles of haul route maintenance activity does not provide for full access to the area to be able to implement the proposed action and would require additional temporary roads. There would be a short-term benefit to transportation system safety through improved surfacing and signage during the life of the project. If the roads are not on a long term maintenance schedule, the effect to the safety of the transportation system would decrease as drainages and road surfaces continue to degrade. A long term road maintenance schedule after the life of this project is outside the scope of this analysis.

An indirect effect of the proposed thinning activities would be improved site distance from the removal of vegetation. This effect would decrease over time as vegetation becomes reestablished. However, the desired condition is for an open stand condition and these effects would be effective in both the short term and a portion of the long term. Routine maintenance activities that occur during the life of this project would also maintain site distances. The negative effects of roads on soil and water resources would be decreased (see the soil and water quality and riparian specialist report). The spot surfacing and graveling component of this activity would require the use of a local rock source (either commercial or rock sources on Forest Service land), but would not deplete all available rock sources in or adjacent to the project area. The total amount of material necessary is not quantifiable at this time, but would be identified with specific road packages as implementation proceeds. There would be energy use necessary for this activity for equipment to be able to maintain roads and haul trucks to transport material. The amount of energy use would be minimized for haul needs of material by utilizing the closest pit available for the material type needed for the project.

Road reconstruction actions in the vicinity of ephemeral, intermittent, and perennial streams would have a limited effect to the needed transportation system for access because the existing transportation system could be utilized (in its current location). Reconstruction would provide a related short-term and long-term benefit to soil and water resources that are discussed within the soil and water quality specialist report. The reconstruction away from streams would provide a slight (due to number of miles) but major improvement in the ability to maintain roads, and as such, would provide a short-term and long-term benefit to a more affordable and safe road system (on those miles that would be treated). Reconstruction by definition would require the use of a local rock source (either commercial or rock sources on Forest Service land), but would not deplete all available rock sources in or adjacent to the project area.

Temporary and closed system roads would provide access to the area to implement the project. This would be primarily a short-term effect that would occur during the first 10 years of the project. A small, unquantifiable portion of this effect would be expected to occur after a 10-year timeframe due to implementation timeframes associated with contracts. Effects to soil and water resources, as well as recreation resources, would be expected to occur during this timeframe and are discussed within the respective specialist reports. Temporary road construction would be governed by contract specifications to minimize resource impacts to soil and water, wildlife, and recreation resources, and would utilize design features within these specialists' reports to minimize impacts to the respective resources.

The decommissioning of 42 miles of current system roads on the Coconino NF would begin to move the road system toward a safe and more affordable transportation system. The bulk of this work would be expected to occur in the short term of the first 10 years of the project. The 42 miles of decommissioned system road would be a long term beneficial effect and would move toward a more affordable transportation system.

Decommissioning would occur on approximately 904 miles of road in these alternatives. This activity would occur after the removal of forest products and would not have an effect on having a transportation system in place (to provide access for implementation). There may be a negative effect to access from implementing prescribed fire in alternatives B and C. There may be a negative effect on approximately 904 miles of roads in both the short term and the long term, and an indirect effect to implementation if roads slated for decommissioning are to be used as fire lines/containment lines for prescribed burns. This would primarily be a long-term effect on maintenance due to the timeframe for naturalization of decommissioned roads (10 years).

In alternative D, the acres of prescribed fire would be decreased, and the corresponding road mileage that would be used to access prescribed fire sites would be decreased to about 225 miles of road. Alternative D also has an indirect effect to implementation if 225 miles of road slated for decommissioning are used as fire lines/containment lines for prescribed fires. The decommissioning of about 904 miles of road would have a short term and long term positive effect on creating a safe and more affordable transportation system.

Forest Plan Amendments

On both forests, the proposed forest plan amendments address management in MSO habitat, management of canopy cover, managing select acres for an open reference conditions, and propose using vegetation and prescribed fire treatments in the proposed Garland Prairie RNA on the Kaibab NF (alternative C only). No road activities would be affected by implementing (or not implementing) the proposed amendments.

Cumulative Effects

The cumulative effects boundary is the approximately 990,000-acre analysis area. The timeframe of the cumulative effects analysis for past projects is 10 years. Table 4 in the specialist report displays the projects within the analysis area and the corresponding roads related decisions within the projects.

There are about 251 miles of road decommissioning within previous projects. This project would add an additional 904 miles of decommissioned roads. The total of about 1,155 miles of decommissioned roads would move the cumulative effects analysis area closer to a safer and more affordable road system.

In addition (see table 4 in the specialist report), there are 0.8 mile of road reconstruction in other projects that add to the 10 miles of road reconstruction from the 4FRI project for a total of 10.8 miles of road reconstruction. This would have a limited effect on creating a safer and more affordable road system. As stated above, the 30 miles of road improvement will improve safety. Thus, there are a total of about 1,198 miles (1,155 miles of decommissioned roads, 30 miles of road improvements, and 10.2 miles of relocated roads) of action proposed between past, present, and future foreseeable roads projects and the 4FRI project that would contribute toward a safer and more affordable road system.

Climate Change

Introduction

Climate scientists agree that the earth is undergoing a warming trend, and that human-caused elevations in atmospheric concentrations of carbon dioxide (CO_2) and other greenhouse gases (GHGs) are among the causes of global temperature increases. The observed concentrations of these greenhouse gases are projected to increase. Climate change may intensify the risk of ecosystem change for terrestrial and aquatic systems, affecting ecosystem structure, function, and productivity (USDA 2010).

Southwestern ecosystems have evolved under a long and complex history of climate variability and change. Taking into consideration the number of mega-droughts and other climate related variation, through time, southwestern systems have some built-in resilience (see silviculture report). However, between 1984 and 2006, an estimated 18 percent of southwestern coniferous forest was lost to increased fire and bark beetle outbreaks likely resulting from drought and high average temperatures (Williams et al. 2010) (see wildlife report).

This analysis synthesizes the direct and indirect environmental consequence information from the specialist reports (as applicable). It incorporates by reference the two planning documents, the "Kaibab National Forest's Climate Change Approach for Plan Revision" (USDA 2012) and the "Southwestern Region Climate Change Trends and Forest Planning" (USDA 2010). See the specialist reports for cumulative effects analyses that consider climate.

Current Conditions and Trends

Southwest Climate Influences

Only a summary of the Southwest climate influence is described here as the "Southwestern Region Climate Change Trends and Forest Planning" (USDA 2010) is incorporated by reference. The climate of the southwestern United States is often referred to as dry and hot; however, it is very complex. While low deserts of the Southwest experience heat and drying winds in the early summer, forested mountain areas and plateaus may experience cold and drifting snow during winter. Climate variability is the norm within this region, as temperature and precipitation fluctuate on time scales ranging from seasons to centuries. The major feature that sets climate of the Southwest apart from the rest of the United States is the North American Monsoon, which, in the U.S., is most noticeable in Arizona and New Mexico. Up to 50 percent of the annual rainfall of Arizona and New Mexico occurs as monsoonal storms from July through September (Sheppard et al. 2002) (USDA 2010).

While many factors influence climate in the Southwest during a particular year or season, predictable patterns hold across the years and decades to define the region's climate. In summary:

- The overall aridity relates to a global circulation pattern known as Hadley circulation, which creates a semipermanent high-pressure zone over the Southwest.
- Relatively high temperatures with dynamic daily swings define this geographic region.
- Mountains and other differences in elevation affect local climate patterns.
- The North American Monsoon works to bring moisture from the tropics into the region during the summer months (USDA 2010).

Based on current projections, the primary regional level effects of climate change most likely to occur in the Southwest include: warmer temperatures, decreasing precipitation, decreased water availability with increased demand, and increased extreme disturbance events. These climate change factors could, in turn, affect ecological, weather related disturbances, and socioeconomic demands, including increases in:

- Frequency of extreme weather events (intense storms);
- Wildfire risks;
- Outbreaks of insects, diseases, and spread of nonnative invasive species;
- Water scarcity coupled with increased demand;
- National forest socioeconomic uses and demands; and
- Changes in habitat quality and quantity for certain desired wildlife and plant species (USDA 2012).

Climate Change Threats to Local Resources

The purpose of the 4FRI project is to reduce the threats to resources that would be intensified with climate change. Currently, over 50 percent of the forested acres in the project area have reduced resiliency. Reduced resiliency increases the potential for severe effects from wildfire, density-related mortality in trees, and reduced resiliency to insect and disease. Currently, over 34 percent of the project area could sustain high-severity effects from crown fire. Treatments have been designed to increase forest resiliency and sustainability. Resiliency should increase the ability of the ponderosa pine forest in the project area to survive natural disturbances such as fire, insects and disease, and the extreme weather events associated with climate change. Some resources at risk in the project area include rare and endemic plants, soil and watersheds, and recreation settings:

Rare and Endemic Plants: As environmental conditions change, the ability of rare and endemic plant species to adapt may be negatively affected. Water availability may decrease in some areas while temperatures generally increase. Climate change, coupled with other factors such as habitat loss, could lead to extirpations and increased risks of extinction.

Soils and Watersheds: Uncharacteristic wildfires could result in a loss of soil productivity and sediment delivery to connected stream courses. Decreased soil moisture due to less precipitation expected from climate change and impaired or unsatisfactory soil conditions from wildfire events may lead to an overall decrease in long term soil productivity. There may also be a loss of sequestered carbon through burning of the overstory and increased erosion rates.

Recreation Settings: Desired recreation setting characteristics such as large, mature trees, healthy understory, and diversity of tree age classes, sizes, and species would be at high risk from the effects of climate change. Unmanaged forests have shown increases in tree stress and mortality as a result of global warming, and old, mature trees are especially vulnerable (Ritchie 2008, VanMantgem et al. 2009, Williams et al. 2010).

Climate change has the potential to affect burn frequency, carbon storage, and noxious weeds:

Burn Frequency and Carbon Storage: Woods et al. (2012) found that, although burn frequency affected the rate and total amount of carbon storage in a ponderosa pine forest, both 20-year and 10-year fire return intervals produced forests that were net carbon sinks, while the no action alternative forest became a net carbon source. Figure 47 displays carbon storage per acre comparing a no action “baseline” scenario with 10- and 20-year fire return intervals in a ponderosa pine forest of northern Arizona (adapted from Woods et al. 2012).

Noxious Weeds: Climate change is expected to be a source of widespread disturbances, and disturbance is a major factor in noxious weed invasions. Higher temperatures would occur and precipitation cycles would be modified from current patterns over large areas.

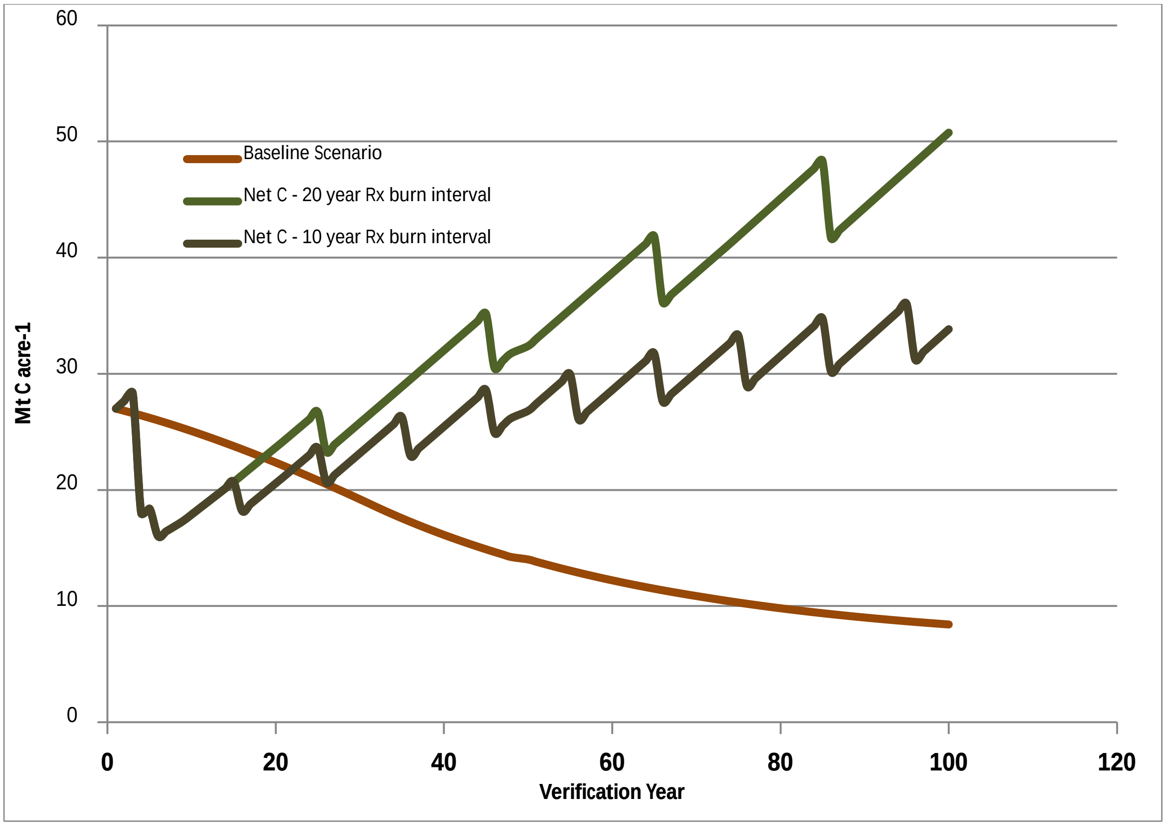


Figure 47. Carbon storage per acre comparing the no action baseline scenario with 10- and 20-year fire return intervals (Woods et al. 2012)

Strategies to Address Climate Change

In 2010, The Nature Conservancy (TNC) hosted a series of climate change workshops with the objective being to address climate change questions related to forest and wildlife health, and impacts to communities within the 4FRI area. Long term (2040 to 2060), high priority strategic recommendations from the workshop included thinning to create a mosaic of clumps and groups of trees with intermixed openings, treating more acres with prescribed burns, and allowing more wildland fire to burn (see wildlife report).

This is in alignment with the strategy developed by the Southwestern Region of the Forest Service (USDA 2010). Actions to address climate change are those that:

- Enhance adaptation by anticipating and planning for disturbances from intense storms,
- Reduce vulnerability by restoring and maintaining resilient native ecosystems,
- Increase water conservation and plan for reductions in upland water supplies,

- Anticipate increases in forest recreation,
- Use markets and demand for wood and biomass for restoration, renewable energy, and carbon sequestration, and
- Monitor climate change influences.

The 4FRI project encompasses several of the strategies to address climate change including (but not limited to) creating groups of trees with openings, returning fire to the landscape, and improving soils and watershed conditions.

Environmental Consequences

The scope of this analysis is confined to the project area which encompasses almost 1 million acres. This scale is most relevant to the questions (USDA 2009) addressed by the analysis:

1. How would climate change affect movement toward the project's purpose and need which focuses on restoring function and resiliency to the ecosystem? The indicators are:
   - Qualitative assessment of how the indicators of climate change would affect vegetation, fire risk and behavior, rare and endemic plants, noxious weeds, soil productivity and watershed function, wildlife species and habitat, and socioeconomic use and demand, including grazing and recreation.
2. How would the project impact climate change in terms of storing or releasing carbon into the atmosphere? The indicator is:
   - Short-term and long-term emissions and alterations to the carbon cycle caused by mechanical treatments and use of prescribed fire.

Alternative A

For vegetation resources, under the projected future climate conditions, dense forest conditions resulting from the no action alternative would be at a high risk of density related and bark beetle mortality. Vegetation would have limited resilience to survive and recover from potential large-scale impacts. Under drier and warmer weather conditions, the potential impacts of these risks to the ecosystem would be increased. Carbon stocks would remain high.

Individual tree growth would be low to the point of stagnation. As tree density increases, many areas would experience higher mortality (release of carbon) than growth (carbon storage). This trend would result in areas becoming a carbon source to the atmosphere (see silviculture report).

Although fire-excluded forests contain higher carbon stocks, this benefit is outweighed in the long term by the loss that would be likely from uncharacteristic stand-replacing fires if left untreated (Hurteau et al. 2011). In alternative A, 34 percent of the area would have the potential for high-severity fire effects from crown fire. Large-scale fire events that could occur with no treatment (alternative A) could release significant amounts of carbon into the atmosphere. Kolb et al. (2007) have shown that biomass and carbon may fail to recover. The Horseshoe Fire (on the Kaibab NF) was still a net carbon source 15 years after the fire (figure 48 and figure 49). Savage & Mast (2005) showed that these conditions can persist for decades (see fire ecology report).

Figure 48. Fifteen years after the Horseshoe Fire (photo from November 2011)

Figure 49. Healthy ponderosa pine forest

Alternative A would not improve the ability of rare and endemic plant species to adapt to suitable areas. Climate change coupled with other factors such as habitat loss could lead to extirpations and increased risks of extinction.

Approximately 34 percent of the project area would be at risk from severe high effects from crown fire. Larger and more frequent fires would be expected (Marlon et al. 2009). Climate may favor the spread of invasive exotic grasses into arid lands where the native vegetation is too sparse to carry a fire. When these areas burn, they typically convert to nonnative monocultures and the native vegetation is lost (USDA 2010).

Implementation of alternative A would put soils and watersheds at risk of continued uncharacteristic wildfires that could result in loss of soil productivity and sediment delivery to connected stream courses. Soil erosion models indicate that approximately 24 percent of all soils left untreated could be subject to soil erosion above tolerable levels from severe wildfires if all soils burned under condition of high-burn severity (see water quality and riparian report).

In alternative A, approximately 82,592 acres of ongoing vegetation treatments and 96,125 acres of ongoing prescribed fire projects would continue to be implemented adjacent to the treatment area. Approximately 86,771 acres of vegetation treatments and 142,869 acres of prescribed fire and maintenance burning would be implemented adjacent to the treatment area by the forests in the foreseeable future (within 5 years). Alternative A does not contain thinning activities that would open the canopy and allow for improved soil condition and productivity in about 600,000 acres of the project area. Within these acres, long-term soil productivity is not expected to be improved from the beneficial effects from an increase in grass species that corresponds to a larger root network essential in loosening up and improvement of soil structure and promotes better water infiltration, air exchange, and soil microbial cycling of nutrients. Water storage in soil is not expected to improve and with an expected decrease in precipitation as is predicted with climate change, there would be less water available to plants.

In the no action alternative under drier and warmer weather conditions, individual tree growth would be limited to the point of stagnation. As tree density increases, many areas would experience higher mortality. Wildlife species requiring closed canopy forest conditions or old or large tree, snag, and log structure would be negatively impacted in the long term. Open forest, savanna, and meadow and grassland habitats would potentially increase in the long-term (see wildlife report).

For uses such as authorized grazing, allotment use is managed to respond to seasonal and annual changes in forage production. Increased temperatures combined with decreased precipitation could lead to lower plant productivity and cover which, in turn, could decrease litter cover. In the past, to address drought, some allotments were completely destocked while others were reduced to as little as 20 percent stocking. Allotment management would change as forage productivity changes from climate (see range report).

For recreation resources, climate change was only evaluated as part of cumulative effects. In alternative A, increased tree mortality and loss of large, mature trees would result in a cumulative decrease in recreation settings within the project area.

Alternatives B, C, and D

Under projected, future climate conditions, restoration treatments (e.g., mechanical treatment, prescribed fire) in alternatives B, C, and D would promote low-density stand structures, characterized by larger, fire-resistant trees (see silviculture specialist report). Mechanical treatment and prescribed burning would help to mitigate the negative impacts of stand-replacing fire in dry, dense forests by consuming less biomass and releasing less carbon into the atmosphere (Finkeral and Evans 2008, Wiedinmyer and Hurteau 2010).

Some of the carbon within the estimated 366,159,029 cubic feet (alternative B) to 367,737,165 cubic feet (alternative C) of biomass removed by mechanical thinning would be sequestered for a time in the form of building materials (silviculture specialist report). This assertion is supported by Ryan et al. (2010) who found that wood products which substitute standard building materials such as steel and concrete produce far less greenhouse gas emissions during their production while simultaneously sequestering carbon (Fire Ecology Report). Finkeral et al. found that while the treatment initially produced a 30 percent reduction in the carbon held in trees, it significantly reduced the threat of an active crown fire, which they predicted would kill all the trees and release 3.7 tons of carbon per acre in any untreated areas.

Alternatives B-D reduce the potential for high-severity effects from crown fire by about 27 percent when compared to alternative A. Mechanical treatment and prescribed fire that produce only low- to moderate-severity effects would reduce onsite carbon stocks and releases carbon into the atmosphere at a lower rate than high-severity fire.

The low to moderate effects that would result from alternatives B-D should afford for greater carbon storage in southwestern fire-adapted ecosystems over time (Hurteau and North 2009). Research by Hurteau and North (2009) has also shown that the long-term gains acquired through prescribed fire and mechanical thinning outweighs short-term losses in sequestered carbon. In the long term (e.g., 100 years), thinning and burning would create more resilient forests less prone to stand-replacing events and, subsequently, able to store more carbon in the form of large trees.

For rare and endemic plant species, the actions proposed in alternatives B–D would provide more resiliency to local vegetative communities (see silviculture and wildlife understory analysis), restore natural fire regimes, and reduce the risk of habitat loss due to severe high effects (see fire ecology report). These actions are particularly important to all endemic species analyzed with one exception, Bebb’s willow (see botany report).

In alternatives B–D, potential increase/spread of noxious or invasive weeds caused by disturbance would be reduced to a nonsignificant level by incorporating the mitigations, BMPs, and noxious or invasive weed treatments for the project. Increasing forest resiliency and function within the project area would diminish the impacts of climate change.

It is important to understand that in order to realize a management based net gain in soil carbon, there must be an increase in carbon entering the soil through a productivity increase over current levels or a decrease in decomposition and erosion (Neary et al. 2002). Productivity in arid forest ecosystems is low due to moisture limitations and the decomposition rates are among the lowest in the continental U.S. (Neary et al 2002), which is true for this project area.

It is likely that the forests within the project area have more stored carbon than pre-European settlement due to a change in stored carbon from understory to stand level tree productivity (Neary et al. 2002). As stated above, heavily stocked sites are subject to rapid removal of stored carbon through wildfires. The action alternatives propose removal of overstory through harvest on about 388,000 acres in alternatives B and D, and up to about 434,000 acres in alternative C. This is expected to actually decrease the amount of carbon sequestered over current stand conditions, but the harvest action will convert the existing stored carbon onsite to belowground storage, thus reducing its potential loss from wildfire (Neary et al. 2002). Implementation of alternatives B–D would reduce the risk of uncharacteristic wildfire that could result in loss of soil productivity, downstream water quality, and watershed function as well would improve overall soil productivity in the long-run through increased understory vegetation. The increase in ground cover of grasses, forbs, and shrubs, which have higher fine root turnover rates than large, woody plants would result in greater soil organic matter content over time.

The thinning, under the action alternatives, would improve soil condition and productivity for soil infiltration and nutrient cycling because an increase in grass species corresponds to a larger root network essential in loosening up and improvement of soil structure and promotes better water infiltration, air exchange, and soil microbial cycling of nutrients, thus improving the ability of the soil to store water which would mitigate the potential loss of overall net precipitation that is expected with climate change. Decomposition rates are also likely to increase with a grass/forb ecosystem compared to a lignin based forest ecosystem, so there may be an increased loss of soil carbon after treatments as the site transitions to a grass/forb understory. Erosion is expected to decrease across the site with the removal of 900 miles of roads and the reduced risk of stand-replacing wildfires and the expected increase in soil productivity, thus potentially increasing carbon storage onsite. Neary et al. (2002) suggests that "perhaps the best carbon sequestration strategy in these inherently low productivity ecosystems is to return their structures to within their historical range of variability." The action alternatives would move toward a more sustainable carbon sequestration scenario for the project area, especially for soil carbon. Carbon sequestration is a means to counter expected human impacts that exacerbate climate change.

Risks associated with dense forest conditions would be reduced and forest resiliency large-scale disturbance under drier and warmer conditions would be improved by implementing the treatments proposed under alternative B–D. The increased acres of mechanical and prescribed burning in alternative C would be expected to increase forest health and resiliency more than alternative B or D. Individual tree growth would improve, resulting in larger average tree sizes. Wildlife species requiring habitat elements associated with closed canopy forest conditions or old or large tree, snag, and log structure would be more sustainable as forest resiliency improved. Open forest, savanna, and meadow and grassland habitats would remain stable in the long term (wildlife specialist report).

Alternatives B–D would increase forage in 89 percent of the allotments in the project area. Collectively, there would be the no discernible additive (adverse) effects or benefits that were offset by the increase in forage, decrease in moisture, or increase in temperature. Livestock grazing would continue to use adaptive management to match forage production with livestock numbers in a grazing management system (range specialist report).

For recreation resources, climate change was only evaluated as part of cumulative effects. Alternatives B–D, as well as other restoration projects, would cumulatively result in improved forest structure, composition and diversity, and more resilient forest conditions, decreased tree stress, and potential for decreased mortality. This would reduce the risk of losing desired recreation setting characteristics such as large, mature trees, healthy understory, and diversity of tree age classes, sizes, and species.

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, 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 present and future generations of Americans (NEPA Section 101). This disclosure focuses on soil, water, and vegetation resources.

Soils and Water

Overall, ponderosa pine, aspen, and grassland restoration along with other proposed treatments including prescribed fire would be expected to increase ecosystem resiliency to uncharacteristic fire, and move soils and watersheds toward satisfactory and functional condition in both the short and long term and maintain or improve long-term soil productivity and water quality (see soils specialist report and water quality and riparian specialist report).

Vegetation

Short-term effects of tree removal and prescribed fire would reduce intertree competition, and free up growing space for residual trees and understory vegetation. Under all alternatives, the proposed actions and associated design features would not affect long-term productivity of forest vegetation and timber resources (see silviculture specialist report).

Unavoidable Adverse Effects

Alternatives B, C, and D

There would no unavoidable adverse effects to soil and water resources. Potential adverse effects would be minimized or mitigated through appropriate use of resource protection measures such as SWCPs and BMPs as outlined in the “Soil and Watershed Conservation Practices Handbook” (Forest Service Handbook 2509.22)(USDA 1990) and site-specific BMPs included in appendix C.

There would be no unavoidable adverse effects related to forest vegetation and timber resources as adverse effects are mitigated by design features, BMPs, and mitigation.

For MSO, fire and smoke effects from prescribed burning may disturb individual birds in and adjacent to the treatment area, but timing restrictions and low-severity burn prescriptions would reduce impacts and largely lead to no effects or only short-term effects; however, the amount of burning across the landscape under alternatives B, C, and D would create the potential of smoke settling into a PAC. If this did occur, it could potentially lead to adverse effects to individual owls.

For MIS there is likely to be a short-term decrease in habitat quantity and quality for Abert’s squirrel (Coconino NF) and the tassel eared squirrel (Kaibab NF). Habitat quality and quantity would increase in the long term.

In the short term (1 to 5 years), visual disturbances from restoration activities would be within the reference conditions of the area. In the short term (1 to 5 years), the disturbances would be visible and would lower the scenic quality. Potential short-term effects include exposure of bare soil, tree stumps, and contrasting color and texture of surfacing materials. The effects would become less noticeable as natural vegetation is reestablished and the surface material begins to be incorporated into the soil horizon.

Alternatives B, C, and D would cause short term and temporary decreases in provision of recreation opportunities on parts of the Coconino and Kaibab NFs. There may be short-term displacement of recreationists during implementation and a temporary decrease in the quality of recreation settings due to the presence of slash, skid trails, log landings, temporary road construction, and creation of dust and noise from logging operations and log hauling. Logging operations including loss of herbaceous cover, disorderly management activities, and noise and dust, as well as lack of information, have been found to decrease the quality of recreation settings and user satisfaction.

Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained, such as the extinction of a species or the removal of mined ore. Irretrievable commitments are those that are lost for a period of time such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power line rights-of-way or road.

An irretrievable commitment of resources is associated with alternative A. In alternative A, there is the likelihood that there would be additional larger fires with larger areas with higher severity fires than occurred historically. Post-fire effects that require decades of recovery would be irretrievable in the short term and potentially the long term. For example, topsoil which is critical to healthy surface vegetation would take centuries to recover. The loss of old growth and old trees would be irretrievable as it would require decades and centuries to recover. When considered with climate change, it is unknown exactly what the ecological trajectory would be for the replacement of old growth and old trees (see fire ecology report).

Cumulative Effects

A summary of past, present, and reasonably foreseeable management actions and natural disturbances that were evaluated by most resources is located in appendix F. See the project record for the comprehensive master list of all projects and for additional information on each project.

Other Required Disclosures

NEPA at 40 CFR 1502.25(a) directs “to the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with other environmental review laws and executive orders.”

- All affected tribes would be consulted as each project phase (specifically mechanical treatment, spring and channel restoration, and prescribed fire activities) is prepared for implementation per consultation requirements of the National Historic Preservation Act.
- The Arizona State Historic Preservation Office (SHPO) has approved a programmatic agreement for the project and has concurred and provided Section 106 clearance for the project. See the project record for documentation.
- The FWS, in accordance with the ESA implementing regulations for projects with threatened or endangered species, provided informal project design input as the preferred alternative was developed. Formal consultation will begin after the DEIS formal comment period. See the project record for documentation.
- In order to implement springs, streams, and temporary road construction and decommissioning, a 404 permit would be required from the U.S. Army Corps of Engineers. Water quality certification from ADEQ may necessary.

- At this time, there is uncertainty whether a National Pollution Discharge Elimination System (NPDES) permit would be required for stormwater discharges from logging roads associated with this project. Although the Environmental Protection Agency has published a final rule exempting logging road stormwater discharge from NPDES permitting requirements, the United States Supreme Court is currently reviewing the matter. Until the Supreme Court rules, it will be uncertain whether a NPDES permit is required for this project.

Chapter 4 – Consultation and Coordination

Preparers and Contributors

The Forest Service consulted individuals, Federal, State and local agencies, tribes, and non-Forest Service persons during development of this draft environmental impact statement.

The following personnel (table 90) were directly involved with preparation of this draft environmental impact statement (DEIS).

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The following tribes and tribal chapters who have historic ties and an interest in the Coconino and Kaibab National Forests were consulted with and include: Kaibab Band of Paiute Indians, Navajo Nation including Coppermine, Coalmine, Naness, Lechee, Leupp, Bodaway, Cameron, Tuba City, Dilkon and Tolani Lake Chapters, Kaibab Band of Paiute Indians, San Juan Southern Paiute, White Mountain Apache, Yavapai-Apache Nation, San Carlos Apache, Hualapai, Yavapai-Prescott Indian Tribe, Havasupai, Tonto Apache, Pueblo of Zuni, Pueblo of Acoma, Hopi, and Fort McDowell Yavapai Nation.

List of Agencies, Organizations, and Persons to Whom Copies of the DEIS Were Sent

This draft environmental impact statement (DEIS) has been distributed to individuals who specifically requested a copy of the document (see list below). Distribution methods include paper copies, DVDs, and electronic documents posted on the 4FRI Web site: http://www.fs.usda.gov/4FRI. In addition, the document was distributed to the Federal agencies, federally recognized tribes, State and local governments, and organizations noted above.

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Glossary

Active crown fire – A fire in which a solid flame develops in the crowns of trees, but the surface and crown phases advance as a linked unit dependent on each other.

Adaptive management – Provides an implementation tool that goes beyond the "predict-mitigate-implement" model and incorporates an "implement-monitor-adapt" strategy that provides flexibility to account for inaccurate initial assumptions, to adapt to changes in environmental conditions, or to respond to subsequent monitoring information that indicates that desired conditions are not being met (Forest Service 1909.14.1).

Age class – A distinct aggregation (grouping) of trees originating from a single natural event commonly consisting of trees of similar age.

Basal area (BA) – The cross-sectional area of all trees, measured in square feet per acre.

Biomass – Multiple definitions include: organic matter produced by plants and other photosynthetic organisms; total dry weight of all living organisms that can be supported at each level of a food chain or web; dry weight of all organic matter in plants and animals in an ecosystem; plant materials and animal wastes that function as fuel for fire.

Burn – An effect produced by heating. To undergo combustion, consuming fuel and giving off light, heat, and gasses. Also, an area where fire has occurred in the past.

Canopy – A layer of foliage, generally the uppermost layer, in a forest stand. Can be used to refer to midstory or ***understory*** vegetation in multilayered stands.

Canopy base height (CBH) – A critical factor in crown fire initiation and can be used as an indicator of the potential for crown fire initiation (Agee and Skinner 2005, Stratton 2009, Scott 2003). The desired condition is for CBH to be greater than 18 feet in ponderosa pine.

Canopy bulk density (CBD) – For ponderosa pine and pine-oak stands. CBD is a good indicator of potential active crown fire (Stratton 2009, Scott 2003). The desired condition is for average CBD to be less than 0.05 kg/m^3 in ponderosa pine.

Canopy characteristics – Canopy characteristics include canopy cover, canopy base heights (CBH), and canopy bulk density (CBD) which contribute significantly toward the type of fire that can occur (Scott and Reinhardt 2001). Canopy cover, CBH, and CBD directly affect the incidence and behavior of crown fires and are used for modeling potential fire behavior (Scott 2003, Scott and Reinhardt 2005, Agee and Skinner 2005).

Canopy cover – As used in modeling fire in the fire ecology analysis, canopy cover is the horizontal fraction of the ground that is covered directly overhead by tree canopy, the percent of vertically projected canopy cover in the stand (Scott and Reinhardt 2005).

Canopy density – In this analysis, the term "openness" is used interchangeably with the term "canopy density." Openness is the percentage of the forested area that is grass/forb/shrub interspace.

Clean Water Act (CWA) – Act that provides the structure for regulating pollutant discharges to waters of the United States. The act's objective is "…to restore and maintain the chemical, physical, and biological integrity of the Nation's waters," and is aimed at controlling both point and nonpoint sources of pollution. The U.S. EPA administers the act, but many permitting, administrative, and enforcement functions are delegated to state governments. In Arizona, the designated agency for enforcement of the Clean Water Act is the Arizona Department of Environmental Quality (ADEQ).

Closed road – Intermittent service roads that are closed to vehicular traffic. However, these roads may be available and suitable for nonmotorized uses. The closure period must exceed 1 year. Basic custodial maintenance is performed to keep damage to adjacent resources to an acceptable level and to perpetuate the road to facilitate future management activities. Emphasis is normally given to maintaining drainage facilities and runoff patterns. Planned road deterioration may occur at this maintenance level (USDA Forest Service 2005).

Clump – A tight cluster of two to five trees of similar age and size originating from a common rooting zone that typically lean away from each other when mature. A clump is relatively isolated from other clumps or trees within a group of trees. A stand-alone clump of trees can function as a tree group.

Condition class (reference FRCC**)** – A measure of departure from reference conditions that can be used to determine how "at risk" key ecosystem components are in the event of a disturbance event such as fire.

Conditional crown fire – A crown fire that is dependent on ladder fuels in adjacent stands in order for fire to access the crowns. In an area with conditional crown fire, ladder fuels are insufficient in a stand for crown fire to initiate, but canopy fuels are sufficient to support crown fire if it moves in from an adjacent stand.

Contemporary uses – The use of the forest for traditional and cultural purposes by tribes that have aboriginal ties to the land.

Controlled burn – Synonymous with prescribed fire.

Coarse woody debris (CWD) – Woody debris larger than 7.5 cm (3 inches) in diameter (Graham et al. 1994).

Cover type – Refers to a forest or woodland type, such as ponderosa pine, pine-oak, or mixed-conifer.

Crown fire – A fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as independent, conditional, or dependent (active or passive) to distinguish the degree of independence from the surface fire. Crown fires are common in coniferous forests and chaparral shrublands.

Declining – The senescent (aging) period in the lifespan of plants that (for trees) includes the presence of large dead and/or dying limbs, snag tops, large, old lightning scars, and other characteristics that indicate the later life stages.

Density-related mortality – Based upon established forest density/vigor relationships, density-related mortality begins to occur once the forest reaches 45 to 50 percent of maximum stand density, and mortality is likely at density levels over 60 percent of maximum stand density (Long 1985).

Diameter at breast height (d.b.h.) – A standard measure of tree diameter measured approximately 1.5 meters (4.5 feet) above the ground.

Disturbance – Any relatively discrete event or series of events, either natural or human induced that causes a change in the existing condition of an ecosystem, community, or population structure and alters the physical environment.

Disturbance regime – A set of recurring conditions due to a variety of disturbances (e.g., fire, flooding, insect outbreak) and their interaction, which characterize an ecosystem within a historic, natural, or human-induced context, within a given climate. This set of recurring conditions includes a specific range for each of the attributes of these disturbances. These attributes include: frequency, rotation period, intensity, severity, seasonality, patch size and distribution, residual structure, causal agent, the relative influence of each causal agent, and how they interact (Suffling and Perera 2004). The attributes researchers choose to represent a regime will vary depending on a researcher's area of interest (Sousa 1984, Pickett and White 1985, Agee 1993, Skinner and Chang 1996, Turner et al. 2001). An accurate description of a disturbance regime must include the full range of disturbance events, including those that are rare.

Diversity – The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.

Drought – Periods of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance. Drought is a relative term; therefore, any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion. For example, there may be a shortage of precipitation during the growing season resulting in crop damage (agricultural drought), or during the winter runoff and percolation season affecting water supplies (hydrological drought).

Duff – The fermentation and humus layer lying below the litter layer and above mineral soil; consisting of partially decomposed organic matter whose origins can still be visually determined, as well as the fully decomposed humus layer. This layer does not include the freshly cast material in the litter layer, nor in the post-burn environment ash (Brown 2000). The top of the duff is where needles, leaves, fruits, and other castoff vegetative material have noticeably begun to decompose. Individual particles usually are bound by fungal mycelia. The bottom of the duff is mineral soil. There is a gradient, not a clear division between litter and duff.

Ecological restoration – The process of assisting the recovery of resilience and adaptive capacity of ecosystems that have been degraded, damaged, or destroyed. Restoration focuses on establishing the composition, structure, pattern, and ecological processes necessary to make terrestrial and aquatic ecosystems sustainable, resilient, and healthy under current and future conditions (USDA Forest Service 2008).

Environmental justice – The fair treatment and involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The White House, with Executive Order 12898, elevated environmental justice issues to the Federal agency policy agenda. EO 12898 instructs each Federal agency to identify and address "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Clinton 1994).

Ephemeral stream – A stream that flows only briefly during and following a period of rainfall in the immediate locality.

Erosion – The wearing away of the land surface by rain or irrigation water, wind, ice, or other natural or anthropogenic agents that abrade, detach, and remove geologic parent material or soil from one point on the earth's surface and deposit it elsewhere.

Even-aged stand – A stand of trees composed of a single age class in which the range of tree ages is usually plus or minus 20 percent of rotation (SAF 2008).

Even-aged management – The application of a combination of actions that result in the creation of stands in which trees of essentially the same age grow together. Managed even-aged forests are characterized by a distribution of stands of varying ages (and, therefore, tree sizes) throughout the forest area. The difference in age between trees forming the main canopy level of a stand usually does not exceed 20 percent of the age of the stand at harvest rotation age. Regeneration in a particular stand is obtained during a short period at or near the time that a stand has reached the desired age or size for regeneration and is harvested. Clearcut, shelterwood, or seed tree cutting methods produce even-aged stands.

Evidence-based restoration – Using indicators of trees standing at the time of settlement that are no longer present as living trees including snags, downed logs, stumps, and stump holes to guide restoration objectives (ERI 2009).

Fire-adapted ecosystem – An associated group of plant and animals that have made long term genetic changes in response to the presence of fire in their environment.

Fire ecology – The study of fire's interaction with ecosystems.

Fire line intensity – Rate of heat release in the flaming front.

Fire regime – A set of recurring fire conditions that characterize an ecosystem, within a historic, natural, or human induced context, within a given climate. This set of recurring conditions includes a specific range of attributes. Sugihara et al. (2006) use the following attributes: seasonality, frequency (fire return interval), intensity, severity, size, spatial complexity, and fire type. An accurate description of a fire regime will include the full range of fire events, including those that are rare and connect to the larger disturbance regime which contains the fire regime as a subset. There are five fire regimes:

> **Fire Regime I** – 0 to 35 year frequency and low (surface fires most common, isolated torching can occur) to mixed severity (less than 75 percent of dominant overstory vegetation replaced);
>
> **Fire Regime II** – 0 to 35 year frequency and high severity (greater than 75 percent of dominant overstory vegetation replaced);
>
> **Fire Regime III** – 35 to 100+ year frequency and mixed severity;
>
> **Fire Regime IV** – 35 to 100+ year frequency and high severity; and
>
> **Fire Regime V** – 200+ year frequency and high severity.

Fire regime condition class (FRCC) – An ecological evaluation protocol that uses three classes for describing the relative degree of departure from historical fire regimes.

Fire return interval – The number of years between two successive fires in a designated area (i.e., the interval between two successive fires); the size of the area must be clearly specified (McPherson and others 1990).

Fire risk – In the context of technical risk assessments, the term "risk" considers not only the probability of an event, but also includes values and expected losses. Within wildland fire, "risk" refers only to the probability of ignition (both man- and lightning-caused) (Hardy 2005).

Fire type – Flaming front patterns that are characteristic of a fire.

First order fire effects – Effects resulting directly from the fire, such as fuel consumption and smoke production.

Forage – Browse and herbage which is available and can provide food for animals or be harvested for feeding; or to search for or consume forage (ITR 1734-4).

Forbs – A broadleaved, herbaceous plant (e.g., columbine).

Forest health – The perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance. Note perception and interpretation of forest health are influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of the stands that comprise the forest, and the appearance of the forest at a point in time (SAF 2008).

Fuel loads – The amount of combustible material present per unit area.

Group – A cluster of two or more trees with interlocking or nearly interlocking crowns at maturity surrounded by an opening. The size of tree groups is typically variable depending on forest community and site conditions and can range from fractions of an acre (a two-tree group) to many acres. Trees within groups are typically nonuniformly spaced, some of which may be tightly clumped (SAF 2008).

Group selection – A cutting procedure which creates a new age class by removing trees in groups or patches to allow seedlings to become established in the new opening (SAF 1998).

Habitat: A place where an animal or plant normally lives, often characterized by a dominant plant form or physical characteristic. Often described for individual species, e.g., spotted owl habitat, it is usually used as a generalization of where an animal may live (Fire Ecology Report 2013).

Heritage strategy – A strategy developed in consultation with the Arizona State Historic Preservation Officer to assist in reaching a "No Adverse Effect" determination for the project (see heritage specialist report).

Heterogeneity – For the purposes of this analysis, heterogeneity refers to having biodiversity in terms of habitat and forest structure across the landscape.

Historic range of variation (HRV) – Refers to ecosystem composition, structure, and process for a specified area and time period. Historic range of variation (HRV) is often used to determine our best estimate of "natural" conditions and functions and, thus, is often our best estimate of the natural range of variation (NRV). Ecosystems change over time. It is assumed that native species have adapted over thousands of years to natural change and that change outside of NRV may affect composition and distribution of species and their persistence (Fire Ecology Report 2013).

Hydrologic condition – The current state of the processes controlling the yield, timing, and quality of water in a watershed (FSM 2521.05).

Impaired waters – Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters. See the water quality and riparian specialist report for additional information.

Intermediate thinning – The thinning or cutting of trees to improve the composition, structure, condition, health, and growth of remaining trees (SAF 1998).

Interspace(s) – The open space between tree groups intended to be managed for grass/forb/shrub vegetation during the long term. Interspace(s) may include scattered single trees.

Invasive – any species which can establish, persist, and spread in an area, and be detrimental or destructive to native ecosystems, habitats, or species, and is difficult to control or eradicate.

Kaibab health focus: Multi-stakeholder, collaborative process that prioritized areas most in need of treatment. Primary indicators were related to high risk and high value such as those with closed canopies containing large trees. These areas were identified as high priority for restoration because they already contain many components of the desired condition, and a single treatment may come close to meeting the desired condition, but if lost, would take centuries to replace. See *http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5120031.pdf*.

Ladder fuel – Fuel, such as branches, shrubs, or an understory layer of trees, which allow a fire to spread from the ground to the canopy.

Landscape scale – A spatial scale and extent expressed in geographic terms within which to target action, e.g., projects aimed at forest landscape restoration. In this analysis, the landscape scale for vegetation is the ponderosa pine extent.

Large tree – A large tree as defined in the revised "Mexican Spotted Owl Recovery Plan" (USDI 2012) is a tree greater than 18-inch d.b.h.

Litter – The top layer of the forest, shrubland, or grassland floor above the duff layer, including freshly fallen leaves, needles, bark, flakes, fruits (e.g., acorns, cones), cone scales, dead matted grass, and a variety of accumulated dead organic matter which is unaltered or only slightly decomposed. This layer typically does not include twigs and larger stems. One rough measure to distinguish litter from duff is that you can pick up a piece of litter and tell what it was (a leaf or leaf part, a needle, etc.). Duff is generally not identifiable. There is a gradient, not a clear division between litter and duff.

LOPFA – Landscapes outside of goshawk post-fledgling family areas as referenced in the Coconino NF and Kaibab NF forest plans.

Management area – The mission, goals, and objectives for the forest are realized by applying groups of management activities to specific units of land. Groups of management activities are called "prescriptions" and the land units are called "management areas."

Mature tree – A tree that has attained most of its potential height growth.

Mechanical treatment – Any activity (e.g., silvicultural thinning, biomass removal) performed by human-controlled tools (e.g., chain saw, feller-buncher) that results in the removal or alteration of wood fiber. Does not include the use of fire.

Mexican spotted owl habitat – Three levels of habitat management are described in the recovery plan: protected areas, restricted areas, and other forest and woodland types.

Monitoring – A systematic process of collecting and storing data related to natural systems at specific locations and times. Determining a system's status at various points in time yields information on trends, which is crucial in detecting changes in systems.

Mosaic – The spatial arrangement of habitat where there is stand heterogeneity, measured at many spatial scales from the patch, the stand, and the vegetative community.

Native species – a species which is an indigenous (originating where it is found) member of a biotic community. The term implies that humans were not involved in the dispersal or colonization of the species.

Nest/roost recovery habitat – Areas managed to replace nest/roost habitat lost to disturbance or senescence and to provide new nest/roost habitat for a recovering owl population (USDI 2012).

Nonmarket values – The benefits and values associated with national forests that do not have a monetary price including clean water and air, biodiversity, forest products, and other goods and services.

Nutrient cycling (soil) – The circulation of chemicals necessary for life, from the environment (mostly from soil and water) through organisms and back to the environment.

Old growth – The last stage in forest succession. Old-growth habitat is the sum of the physical and biological components of old-growth forest that are essential to maintaining populations of certain old growth dependent species of wildlife (Kaibab NF forest plan glossary).

Old growth protection and large tree retention strategy (OGP and LTRS) – Strategy developed by the 4FRI stakeholders in 2010 (finalized in 2011), which provides recommendations relating to the retention of large post-settlement and old growth trees.

Openness – The percentage of the forested area that is grass/forb/shrub interspace. In this analysis, the term "openness" is used interchangeably with the term "canopy density." Classifications of openness for the 4FRI analysis are:

- Very Open = 70 to 90 percent interspace
- Open = 40 to 70 percent interspace
- Moderately Closed = 25 to 40 percent interspace
- Closed = <25 percent interspace

Operational road maintenance levels – The level of service provided by, and maintenance required for, a specific road, consistent with road management objectives and maintenance criteria (FSH 7709.58, 12.3). There are five levels:

Level 1: These are roads that have been placed in storage between intermittent uses. The period of storage must exceed 1 year. Basic custodial maintenance is performed to prevent damage to adjacent resources and to perpetuate the road for future resource management needs.

Level 2: Assigned to roads open for use by high-clearance vehicles. Passenger car traffic, user comfort, and user convenience are not considerations.

Level 3: Assigned to roads open and maintained for travel by a prudent driver in a standard passenger car.

Level 4: Assigned to roads that provide a moderate degree of user comfort and convenience at moderate travel speeds. Most roads are double lane and aggregate surfaced.

Level 5. Assigned to roads that provide a high degree of user comfort and convenience. These roads are normally double lane, paved facilities.

Overmature tree – A tree that has reached that stage of development when it is declining in vigor and health and reaching the end of its natural lifespan. Indications of later life stages in southwestern ponderosa pine include yellowing bark, large limbs, dead and/or dying limbs, flat tops, snag tops, lightning scars, and burn scars (cat face).

Passive crown fire – A fire in the crowns of trees in which trees or groups of trees torch, ignited by the passing front of the fire. The torching trees reinforce the spread rate, but these fires are not basically different from surface fires.

PFA – Goshawk post-fledgling family area as referenced in the Coconino NF and Kaibab NF forest plans.

Pile burning – Activity fuels, once piled by machine or by hand, are burned in place.

Planned ignition – The intentional initiation of a wildland fire by hand-held, mechanical, or aerial device where the distance and timing between ignition lines or points, and the sequence of igniting them is determined by environmental conditions (weather, fuel, topography), firing technique, and other factors which influence fire behavior and fire effects (see prescribed fire).

Precommercial thinning – The removal of trees not for immediate financial return but to reduce stocking to concentrate growth on the more desirable trees (SAF 2008).

Prescribed fire – A wildland fire originating from a planned ignition to meet specific objectives identified in a written, approved, prescribed fire plan for which NEPA requirements (where applicable) have been met prior to ignition (see planned ignition).

Properly functioning condition (PFC) – A methodology for assessing the physical functioning of riparian and wetland areas. The term PFC is used to describe both the assessment process and a defined, on-the-ground condition of a riparian-wetland area (National Riparian Service Team Definition, 2013).

Protected habitat (Mexican spotted owl) – Protected habitat consists of protected activity centers (PACs), slopes greater than 40 percent where timber harvest has not occurred in the last 20 years (steep slopes), and reserved lands which include wilderness, research natural areas, wild and scenic rivers, and congressionally recognized wilderness study areas. The primary objective for protected habitat is the protection of the best available habitat for Mexican spotted owls while retaining management flexibility to abate high fire risk and to improve habitat conditions for the owl and its prey.

Proposed action – In terms of the National Environmental Policy Act, the project, activity, or action that a Federal agency intends to implement or undertake (Coconino NF forest plan glossary).

Recovery unit – A specific geographic area, identified mainly from physiographic provinces, used to evaluate the status of Mexican spotted owls and within which to develop specific management guidelines (USDI 2012). The recovery unit specific to this analysis is the Upper Gila Mountain Recovery Unit (RU), also referred to as the UGMRU.

Recreational opportunity spectrum (ROS) – A classification system that describes different outdoor recreation settings across the forests using seven standard classes that range from primitive, undeveloped settings to urban, highly developed settings. Attributes typically considered in describing the settings are size, scenic quality, type, and degree of access, remoteness, level of development, social encounters, and the amount of onsite management. See the recreation and scenery report for additional information.

Reference condition (also referred to as historic reference condition) – A range of conditions (found in the present or the past) against which the effects of past and future actions can be compared. These states can provide an explicit, historically-based context for comparing different management effects. Examples include periods before fire suppression or the arrival of an invasive species, or a similar but “healthier” modern ecosystem. Ideally, these environmental conditions are based on functioning ecosystems where natural ecosystem structure, composition, and function are operating with limited human intervention (very minor human-caused ecological effects).

Regenerate – The act of renewing tree cover by establishing young trees naturally or artificially (SAF 2008).

Research natural area (RNA) – An area in as near a natural condition as possible that exemplifies typical or unique vegetation and associated biotic, soil, geologic, and aquatic features. RNAs are set aside to preserve a representative sample of an ecological community, primarily for scientific and educational purposes. Normally between 300 and 1,200 acres in size (Coconino NF forest plan glossary).

Residence time – Time required for the flaming front of a fire to pass a stationary point at the surface of the fuel. The length of time the flaming front occupies one point; relates to downward heating and fire effects below the surface.

Resiliency – The capacity of a (plant) community or ecosystem to maintain or regain normal function and development following disturbance (SAF 2008).

Resource protection measures – Measures (design features or mitigation) implemented to minimize nonpoint source pollution as outlined in the intergovernmental agreement between the Arizona Department of Environmental Quality and the Southwestern Region of the Forest Service (ADEQ 2008).

Restoration subunit (SU) – A contiguous geographic area that ranges from 4,000 acres to 109,000 acres in size. Boundaries are based on 6th code watershed boundaries, state and forest transportation systems, and forest administrative boundaries.

Restoration treatments – Treatments that help recover forest ecosystem resilience and the adaptive capacity of forest ecosystems that have been degraded, or are otherwise outside the natural range of variation that would preclude sustainability through time.

Restoration unit (RU) – A contiguous geographic area that ranges from 46,000 acres to 335,000 acres in size where a need for change (vegetation structure, pattern, spatial arrangement, potential for destructive fire behavior and effects) has been identified. Restoration unit boundaries are based on 6th code watershed boundaries, state and forest transportation systems, and forest administrative boundaries

Restricted habitat (Mexican spotted owl) – In the case of the 4FRI, restricted habitat is ponderosa pine-Gambel oak habitat that does not meet the definitions of protected habitat, i.e., there are no known resident Mexican spotted owls, it is not on a slope with 40 percent or greater slope and has not had timber harvested in the last 20 years, and is not considered a reserved land (e.g., designated wilderness, research natural areas, etc.). The objective in restricted habitat is to manage the landscape to maintain and create replacement owl habitat where appropriate while providing a diversity of stand conditions and stand sizes across the landscape.

Riparian area – Riparian ecosystems are distinguished by the presence of free water within the common rooting depth of native perennial plants during at least a portion of the growing season. Riparian ecosystems are normally associated with seeps, springs, streams, marshes, ponds, or lakes. The potential vegetation of these areas commonly includes a mixture of water (aquatic) and land (phreatic) ecosystems (Coconino NF forest plan glossary).

Road construction or reconstruction – Supervising, inspecting, actual building, and incurrence of all costs incidental to the construction or reconstruction of a road (36 CFR 212.1).

Road decommission – Activities that result in the stabilization and restoration of unneeded roads to a more natural state (36 CFR 212.1, FSM 7705—Transportation System, USDA 2003). FSM 7712.11- Exhibit 01 identifies five levels of treatments for road decommissioning which can achieve the intent of the definition. These include blocking the entrance, revegetation waterbarring, removing fills and culverts, establishing drainageways and removing unstable road shoulders, and full obliteration, recontouring, and restoring natural slopes.

Road reconstruction and improvement – Any activity that results in an increase of an existing road's traffic service level, expansion of its capacity, or a change in its original design function. Activities include, but are not limited to, the construction of bridges and major culverts, placing bar ditches, subgrade repairs, shoulder widening, lane widening, ditch widening, roadway prism widening, horizontal and vertical alignment changes, curve widening, and improving site distance at road intersections. Vegetation would likely be removed with these activities.

Road reconstruction and relocation – Any activity that moves all or parts of the horizontal and vertical alignment of a road, i.e., the roadway prism to a new location and decommissions the old alignment. Generally, realignments are for the purpose of moving the road location to a more suitable area to mitigate impacts to streams, critical wildlife habitat, and other natural or cultural resources. Often, reconstruction is used interchangeably with road relocation. This activity includes creating a new road alignment in an upland position, installing the proper drainage features, signage, and surfacing on the new road alignment, and decommissioning of the old road alignment. The new road alignment would require the removal of vegetation at the new alignment site.

Road (route) obliteration – See road decommission.

Road realignment – Activity that results in a new location of an existing road or portions of an existing road and treatment of the old roadway.

Scenery management systems (SMS) – Guidance developed by the Forest Service for managing scenery and determining the relative value and importance of scenery in the national forest (also see VMS and the scenery specialist report for additional information).

Second order fire effects – The secondary effects of fire such as tree regeneration, plant succession, and changes in site productivity. Although second order fire effects are dependent, in part, on first order fire effects, they also involve interaction with many other nonfire variables (e.g., weather).

Severity – The quality or state of distress inflicted by a force. The degree of environmental change caused by a disturbance (e.g., fire).

Slash – The residue left on the ground after timber harvest or as a result of storms, fire, girdling, or poisoning. Slash includes unused logs, uprooted stumps, broken or uprooted stems, and the heavier branchwood, lighter tops, twigs, leaves, bark, and chips.

Snag – Standing dead tree from which the leaves or needles have fallen.

Soil function – The characteristic physical and biological activity of soils that influences productivity, capability, and resiliency (FSM 2521.05).

Soil productivity – The capacity of soil, in its normal environment, to support plant growth.

(Soil) Tolerance – The point beyond which there is high risk that potential may be permanently altered or impaired through changes in specified physical, chemical, and biological factors brought about by management activities or natural events (FSM 2521.05).

Spatial pattern – Arrangement of forested areas and openings on the landscape.

Spring – In this analysis, springs are natural water features that existed prior to Euro-American settlement and were probably functional due to lack of human disturbances (USDA 2009).

Stand – A contiguous area of trees sufficiently uniform in forest type, composition, structure, and age class distribution, growing on a site of sufficiently uniform conditions to be a distinguishable unit. Four classification characteristics are generally used to distinguish forest stands: biophysical site (soils, aspect, elevation, plant community association, climate, etc.), species composition, structure (density, and age (1-aged, 2-aged, uneven-aged)), and management emphasis (administrative requirements and local management emphasis that will shape structure over time). Based upon Agency guidelines, the minimum stand mapping size is 10 acres.

Stand density – A measure of the degree of crowding of trees within stocked areas commonly expressed by various growing space ratios (e.g., height/spacing) (SAF 2008).

Stand density index (SDI) – A measure of the stocking of a stand of trees based on the number of trees per unit area and diameter at breast height (d.b.h.) of the tree of average basal area. It may also be defined as the degree of crowding within stocked areas, using various growing space ratios based on crown length or diameter, tree height or diameter, and spacing. The computed value of SDI is often compared to the species maximum to determine the relative “stand density” or stocking of the stand.

Stand structure – The horizontal and vertical distribution of components of a forest stand including the height, diameter, crown layers, and stems of trees, shrubs, herbaceous understory, snags, and down woody debris (SAF 2008).

State Historic Preservation Office (SHPO) – The state office responsible for consultation and assistance regarding the presence and significance of cultural resources in a project area, efforts needed to find and evaluate them, whether the project will cause harmful effects to the cultural resource, and how to reduce or avoid the harm.

Stratum/strata (plural) – A layer of soil with internally consistent characteristics that distinguish it from other layers.

Surface fire – A fire that burns over the forest floor, consuming litter, killing aboveground parts of herbaceous plants and shrubs, and typically scorching the bases and crowns of trees. See also backing fire, crown fire, fire, flanking fire, ground fire, head fire, and understory fire.

Surface fuel – Fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low stature living plants. See also duff, fuel, large woody debris, and litter.

Target habitat – A category of Mexican spotted owl restricted habitat intended to provide future nesting and roosting habitat (see definition for restricted habitat). A variety of forest structural attributes is used to define nesting and roosting habitat (summarized in table III.B.1 of the recovery plan and table C-2 of the draft recovery plan). The minimum values identified for the forest attributes represent the threshold for meeting nesting and roosting conditions (see the definition for threshold habitat). They can also be targets to be achieved with time and management. If less than 10 percent of the restricted habitat in ponderosa pine-Gambel oak qualifies as threshold habitat, the areas that can eventually achieve all threshold conditions simultaneously should be identified as *target habitat* and managed to achieve threshold conditions as rapidly as possible. Because no known Mexican spotted owl nests or roosts occur in restricted habitat, target habitat is considered future nesting and roosting habitat.

Temporary road or trail – A road or trail necessary for emergency operations or authorized by contract, permit, lease, or other written authorization that is not a forest road or trail and that is not included in a forest transportation atlas (36 CFR 212).

Threatened and endangered species – Species identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act, as amended. See the wildlife report for additional information.

Threshold habitat – A category of Mexican spotted owl restricted habitat intended to provide for future nesting and roosting habitat (see definition for restricted habitat). A variety of forest structural attributes is used to define when nesting and roosting habitat is achieved (summarized in table III.B.1 of the recovery plan and table C-2 of the draft recovery plan). These values are targets that can be achieved with time and management (see definition for target habitat). When the minimum values identified for the forest attributes are met simultaneously, they represent the *threshold* of nesting and roosting conditions. Ten percent of restricted habitat in ponderosa pine-Gambel oak should be designated as threshold habitat. Management in threshold habitat cannot lower any of the forest attribute values below the nesting and roosting threshold unless a landscape analysis demonstrates an abundance of this habitat. Because no known Mexican spotted owl nests or roosts occur in restricted habitat, target habitat is managed as future nesting and roosting habitat.

Total maximum daily load (TMDL) – A written analysis that determines the maximum amount of a pollutant that a surface water can assimilate (the "load"), and still attain water quality standards during all conditions. The TMDL allocates the loading capacity of the surface water to point sources and nonpoint sources identified in the watershed, accounting for natural background levels and seasonal variation, with an allocation set aside as a margin of safety. See the water quality and riparian specialist report for additional information.

Torching – See passive crown fire.

Traditional cultural property (TCP) – Traditional use areas and places that have been used by cultural groups over generations. TCPs within the project area include the San Francisco Peaks on the Coconino NF and Red Butte and Bill Williams Mountain on the Kaibab NF. Natural springs are also considered TCPs and/or sacred sites by some tribes. Many plants are gathered for ceremonial use on or near TCPs. See appendix A of the heritage report for additional discussion on management of TCPs.

Travel Management Rule (TMR) – On December 9, 2005, the Forest Service published the TMR. The Agency rewrote direction for motor vehicle use on National Forest System lands under 36 CFR, Parts 212, 251, and 261, and eliminated 36 CFR 295. The rule was written to address, at least in part, the issue of unmanaged recreation. The rule provides guidance to the Forest Service on how to designate and manage motorized recreation on the forests. The rule requires each national forest and grassland to designate those roads, motorized trails, and areas that are open to motor vehicle use.

Trees per acre (TPA) – a count of the total number of trees on an acre.

Unauthorized road – A road that is not a forest road or a temporary road or trail and that is not included in a forest transportation atlas (36 CFR 212).

Understory – The trees and other woody species growing under a more or less continuous cover of branches and foliage formed collectively by the upper portion of adjacent trees and other woody growth. In this analysis, the term understory is also referred to as “herbaceous understory.”

Uneven-aged forests – Forests that are comprised of three or more distinct age classes of trees, either intimately mixed or in small groups.

Uneven-aged management – The application of a combination of actions needed to simultaneously maintain continuous high forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes (to provide a sustained yield of forest products). Cutting is usually regulated by specifying the number or proportion of trees of particular sizes to retain within each area, thereby maintaining a planned distribution of size classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection.

Vegetation structural stage (VSS) – A method of describing forest age and tree size from seedling to old forests. The VSS classification is based on the tree size class with the highest square foot of basal area and is an indication of the dominant tree diameter distribution (see silvicultural report for details (McCusker, 2013).

Visual Management System (VMS) – The VMS was used to develop visual quality objectives (VQOs) that are prescribed in the forest plan for all lands within the CNF. The VQO classifications range from preservation, retention, partial retention, modification, to maximum modification. The VMS process has been updated in the Scenery Management System (SMS). See the scenery report for additional information.

Watershed – The area that contributes water to a drainage or stream (Coconino NF forest plan glossary).

Watershed condition – The state of a watershed based upon physical and biological characteristics and processes affecting hydrologic and soil functions (FSM 2521.05).

Watershed condition framework – A framework established by the Forest Service that provides a new consistent, comparable, and credible process for improving the health of watersheds on national forests and grasslands. The framework includes a technical guide which provides protocol for assessing watershed condition across all 193 million acres of National Forest System lands (http://www.fs.fed.us/publications/watershed).

Water quality – See Clean Water Act

Water yield – The total net amount of water produced including streamflow and groundwater recharge (Coconino NF forest plan glossary).

Wildland fire – A general term describing any nonstructure fire that occurs in the wildland.

Wildland-urban interface (WUI) – The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetation fuels. WUI areas are spread across the project area and are located within or adjacent to the communities of Flagstaff (RU 1, 3, 4, 5), Williams (RU 3, 4), Tusayan (RU 6), Parks (RU 3, 4), Belmont (RU 3, 4), and scattered developments such as Doney Park (RU 5), Munds Park (RU 1), and Kachina Village (RU 3).

Woody debris – The dead and downed material on the forest floor consisting of fallen tree trunks and branches.

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- Chapter 1 Tree Density and Canopy Openness – see Silviculture References
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- Chapter 1 Aspen –see Silviculture and Cumulative Effects References
- Chapter 1 Grasslands – see Cumulative Effects and Fire Ecology References
- Chapter 1 Forest Resiliency (Fire) – See Fire Ecology References
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Appendix A – Map Packet

Note: Hard copies of the DEIS include a packet of poster-sized maps for alternatives B, C, and D. Electronic copies of the DEIS are available in DVD and web-based formats. For those viewing the DEIS electronically, map packets are available upon request.

Appendix B – Forest Plan Amendments

Table 91 summarizes the proposed forest plan amendments by alternative and theme. For electronic copy viewers, hyperlinks to each amendment are provided.

Table 91. Summary of forest plan amendments by alternative and theme

Alt.	Mechanical Treatments in PACs – Coconino NF Only	Treatments in PAC Core Areas – Coconino NF Only	Restricted Habitat Management	Basal Area (BA) in Restricted Target and Threshold Habitat – Coconino and Kaibab NFs	Population and Habitat Monitoring – Coconino and Kaibab NFs	Habitat Treatment in Incremental Percentages
Forest Plan Amendment Theme: MSO Habitat Management						
A	NA	NA	NA	NA	NA	NA
B	Coconino NF Amendment 1 Allows mechanical treatment up to 16-inch d.b.h. in 18 PACs	NA	Coconino NF Amendment 1 Kaibab NF Amendment 2 Adds definitions for target and threshold habitat, allows managing for less than 10% target or threshold habitat	NA—Basal area in restricted target and threshold habitat remains 150 on both forests	Coconino NF Amendment 1 Kaibab NF Amendment 2 Defers monitoring to the project's FWS biological opinion	Coconino NF Amendment 1 Kaibab NF Amendment 2 Defers treatment design to the project's FWS biological opinion
C	Coconino NF Amendment 1 Allows mechanical treatment up to 18-inch d.b.h. in 18 PACs	Coconino NF Amendment 1 Allows prescribed fire in 56 core areas	Coconino NF Amendment 1 Kaibab NF Amendment 3 Adds definition of restricted and threshold habitat, allows managing for less than 10% target or threshold on Coconino NF and Kaibab NF	Coconino NF Amendment 1 Kaibab NF Amendment 3 Allows for managing 6,321 acres on the Coconino NF and 2,090 acres on the Kaibab NF of restricted target and threshold habitat for a range of 110 to 150 BA	Coconino NF Amendment 1 Kaibab NF Amendment 3 Defers monitoring to the project's USFWS biological opinion	Coconino NF Amendment 1 Kaibab NF Amendment 3 Defers treatment design to the project's USFWS biological opinion

Alt.	Mechanical Treatments in PACs – Coconino NF Only	Treatments in PAC Core Areas – Coconino NF Only	Restricted Habitat Management	Basal Area (BA) in Restricted Target and Threshold Habitat – Coconino and Kaibab NFs	Population and Habitat Monitoring – Coconino and Kaibab NFs	Habitat Treatment in Incremental Percentages
D	Coconino NF Amendment 1 Allows mechanical treatment up to 16 inch d.b.h. in 18 PACs	NA	Coconino NF Amendment 1 Kaibab NF Amendment 2 Adds definitions for target and threshold habitat, allows managing for less than 10% target or threshold habitat on the Coconino NF and Kaibab NF	NA—basal area in restricted target and threshold habitat remains 150 on both forests	Coconino NF Amendment 1 Kaibab NF Amendment 1 Defers monitoring to the project's USFWS biological opinion	Coconino NF Amendment 1 Kaibab NF Amendment 2 Defers treatment design to the project's USFWS biological opinion

Alt.	Description
	Forest Plan Amendment Theme: Management of Canopy Cover and Ponderosa Pine with an Open Reference Condition within Goshawk Habitat
A	NA
B–D	Coconino NF Amendment 2, Kaibab NF Amendment 1: For both the Coconino NF and Kaibab NF the amendment: (1) adds the desired percentage of interspaces within uneven-aged stands to facilitate restoration, (2) adds the interspaces distance between tree groups, (3) adds language clarifying where canopy cover is and is not measured, (4) allows 29,017 acres on Coconino NF (alts. B–D) and 27,637 acres on Kaibab NF (alts. B, D) or 27, 675 acres (alt. C only) to be managed for an open reference condition (up to 90 percent open with less than 3 to 5 reserve trees), and (5) adds a definition to the forest plan glossary for the terms: interspaces, open reference condition, and stands.
	Forest Plan Amendment Theme: Management of the Proposed Garland Prairie RNA
A	NA
B	NA
C	Kaibab NF Amendment 2: The amendment would add language to allow prescribed fire and mechanical treatments in order to maintain and/or restore the ecological qualities of the proposed RNA.
D	NA

Alt.	Mechanical Treatments in PACs – Coconino NF Only	Treatments in PAC Core Areas – Coconino NF Only	Restricted Habitat Management	Basal Area (BA) in Restricted Target and Threshold Habitat – Coconino and Kaibab NFs	Population and Habitat Monitoring – Coconino and Kaibab NFs	Habitat Treatment in Incremental Percentages
Forest Plan Amendment Theme: Effect Determination for Cultural Resources						
A	NA					
B–D	Coconino NF Amendment 3: The amendment deletes the standard that would require achieving a “no effect” determination and adds the words “or no adverse effect” to the remaining standard. In effect, management strives to achieve a “no effect” or “no adverse effect” determination.					

Alternative B – Coconino National Forest Site-Specific Nonsignificant Forest Plan Amendments

Three nonsignificant, site-specific forest plan amendments are proposed for alternative B. Table 92 provides the current forest plan direction and the proposed amendment language for comparison purposes.

Related Planning Efforts

A revised MSO recovery plan, issued by the U.S. Fish and Wildlife Service (hereafter referred to as FWS) was finalized in December of 2012 (USDI 2012). The current forest plan is consistent with the previous MSO recovery plan (USDI 1995). At some point in time, the Coconino NF may amend its forest plan to be consistent with the revised MSO recovery plan. For this analysis, a forest plan amendment would be needed to utilize the revised recovery plan direction if it is different than what is currently included in the Coconino NF forest plan.

Currently, the Coconino NF is revising its forest plan. An analysis was conducted to determine how the proposed amendments align with the draft plan (as currently written) (USDA 2011). A revised forest plan may affect the need for amendment 1 through 3 in the following ways:

Amendment 1: The amendment would be in alignment with the draft forest plan (as currently written) in that it defers management of MSOs to direction in the MSO recovery plan. The revised (2012) MSO recovery plan does not limit tree removal from within PACs to a specific d.b.h., nor does it require a specific method for habitat monitoring. Although restricted habitat is referred to as “recovery habitat” and “nest/roost habitats” in the 2012 revised plan (USDI 2012, pp. 3, 4), the project’s desired conditions for nesting and roosting habitat is consistent with the revised recovery plan. The revised plan still recommends that a percentage (10 to 25 percent) of recovery habitat be managed as nesting/roosting (USDI 2012, page VIII). Designating habitat in the project with the best potential would move toward desired percentages in recovery habitat. Amendment 1 would provide additional site-specific requirements at the project scale that would not be precluded by the revised forest plan or the revised (2012) recovery plan (USDI 2012).

Amendment 2: Canopy cover requirements in VSS 4 to VSS 6 and direction for managing goshawk habitat for a balance of VSS is presented differently in the current draft forest plan (USDA 2011, pages 51 to 54). Amendment 2 would be in alignment with the draft forest plan (as currently written) as it: (1) provides for managing crowns of trees within the mid-aged to old groups as interlocking or nearly interlocking (USDA 2011, page 53); (2) manages forest conditions in goshawk PFAs with 10 to 20 percent higher basal area in mid-aged to old tree groups than in goshawk foraging areas and general forest (USDA 2011, Page 51); (3) manages for goshawk nest areas (known and replacement) (USDA 2011, page 53); and (4) generally maintains 3 to 5 reserve trees in management created openings greater than 1 acre in ponderosa pine goshawk foraging areas and PFAs (USDA 2011, page 54), with the exception of acres managed for an open reference condition.

The draft forest plans (as currently written) allow for project-specific plan amendments. The portion of the amendment that allows: (1) deviation from maintaining 3 to 5 reserve trees per acre and (2) having openings up to 90 percent (on lands managed for an open reference condition) would be consistent with what is allowed at the project level.

At the landscape scale, the project would be consistent with forest plan draft desired conditions for ponderosa pine which states, “Forest appearance is variable but generally uneven-aged and open; occasional areas of even-aged structure are present. The forest arrangement is in individual trees, small clumps, and groups of trees interspersed within variably sized openings of grass/forb/shrub vegetation associations similar to historic patterns. Size, shape, number of trees per group, and number of groups per area are variable across the landscape” (USDA 2011, page 51). The terms “interspaces” and “open reference condition” do not appear in the draft forest plans (as written). The amendment would need to continue providing this definition. The definition of “stand” could be removed from the amendment (USDA 2011, page 225). The amendment would provide additional site-specific direction and definitions that apply to landscape restoration that are not precluded by the draft forest plan.

Amendment 3 would not be required. As currently written, the draft forest plan desired condition is to generally manage for no adverse effects and minimize adverse impacts or impacts through consultation (USDA 2012, “Coconino National Forest Draft Land and Resource Management Plan,” November. FW-Hrtg-DC, DC-1, p. 92).

Amendment 1. MSO Habitat Management (Coconino NF)

Amendment 1 is a specific, one-time variance for the Coconino NF restoration project. Once the project is complete, current forest plan direction would apply to the project area. The language proposed does not apply to any other forest project. The amendment would be authorized per direction in the National Forest Management Act of 1976 (NFMA) and its implementing regulations found in 36 CFR 219 (1982).

Amendment Description

The amendment would add language to allow mechanical treatments up to 16-inch d.b.h. to improve habitat structure (nesting and roosting habitat) in 18 MSO PACs.

The amendment, which is specific to restricted habitat in pine-oak, would allow for designating less than 10 percent of restricted habitat on the Coconino NF as target or threshold (i.e., future nesting and roosting habitat) based on the quality of the habitat. Definitions of target and threshold habitat would be added since the current forest plan refers to “threshold” in terms of values and desired conditions (see Coconino NF forest plan, page 65-3.) within restricted habitat and there is no reference to “target” conditions.

The amendment would remove language that limits PAC treatments in the recovery unit to 10 percent increments and language that requires the selection of an equal number of untreated PACs as controls. The amendment would remove language referencing monitoring (pre- and post-treatment, population, and habitat monitoring). Replacement language would defer final project design and monitoring to the FWS biological opinion specific to MSO for the project.

Background

In 2011, biologists from the Coconino and Kaibab NFs, the 4FRI team, and the FWS worked together to review individual MSO PACs within the project area. The evaluation process including site visits and modeling silvicultural treatments and prescribed fire to move existing owl habitat toward the desired conditions described in the 1995 MSO recovery plan (USDI 1995) and forest plan.

There are 99 PACs within the 4FRI project area and 72 PACs within the treatment area. Of the 72, 18 were identified as having habitat that could be improved with vegetation treatments. No PACs proposed for treatment are located in designated wilderness. Each stand within the 18 PACs was modeled to identify treatments that would yield the best existing and future MSO habitat conditions. See the wildlife specialist report “Methodology” section for complete details on the habitat evaluation process.

Mechanical Treatment Up to 16-inch d.b.h. in Select PACs (7,353 acres)

MSO PAC field reviews, data evaluation, and vegetation simulation modeling indicated 18 MSO PACs (approximately 3,388 acres or 10 percent of all PACs acres within the treatment area) would move toward MSO recovery plan desired conditions from mechanically cutting trees up to 9-inch d.b.h. Treatments up to 9-inch d.b.h. are consistent with the forest plan.

An additional 7,353 acres within 18 PACs would have nesting and roosting habitat benefits from cutting trees up to 16-inch d.b.h. Mechanical treatments above 9-inch d.b.h. would facilitate the removal of ladder and canopy fuels which would reduce the fire risk in the 18 PACs. Increasing the range of the mechanical treatment thresholds up to 16-inch d.b.h. within 18 MSO PACs would provide for a higher degree of stand structure improvements to nesting and roosting habitat. The proposal addresses comments from the FWS and is in alignment with the revised MSO recovery plan (USDI 2012). Figure 50 displays the general location of mechanical treatment up to 16-inch d.b.h., prescribed fire, and areas where no treatment is proposed within MSO PACs.

Incremental Treatments and Monitoring Responses to Spotted Owl Treatments

Monitoring assesses the effectiveness of management actions and provides the adaptive framework for more successful management guidelines. Monitoring habitat allows for modeling future forest conditions to determine if there will be adequate habitat to support MSO populations. Monitoring and final project design (addressing incremental treatments) for all proposed activities in all MSO habitat would be developed in consultation with the FWS in a manner specific to this project.

Manage Up to 10 Percent of Restricted Habitat as Target or Threshold

In 2011, biologists from the Coconino and Kaibab NFs, the 4FRI team, and the FWS worked together to develop a geographic layer for restricted habitat across the 4FRI treatment area. Data from the Kaibab and Coconino NFs (based on polygons) was merged with pine-oak data from the Lab of Landscape Ecology and Conservation Biology (raster data; Dr. Steve Sesnie and Jill Rundall, Northern Arizona University). This landscape-scale approach better meets the goal of providing continuous replacement nesting and roosting habitat over space and time, as described in the previous (1995) recovery plan and the 1996 “Record of Decision for the Amendment of Eleven Forest Plans.” A new restricted layer was created within the 4FRI treatment area, including designation of target and threshold habitat as described in the MSO recovery plan.

The Kaibab NF consists of three disjunct ranger districts. The North Kaibab Ranger District is north of the Grand Canyon and in a different recovery unit. No resident MSOs have been identified on the North Kaibab and the district is outside the 4FRI planning boundary. The Tusayan and Williams districts are both south of the Grand Canyon and both districts are in the 4FRI planning boundary. The Tusayan district does not include MSO habitat and there are no records of MSOs occurring on the district. The Williams district has limited pine-oak habitat. In achieving a landscape-scale assessment for the 4FRI, MSO pine-oak habitat was assessed across the Williams district and much of the Coconino NF.

The MSO recovery plan describes past planning as operating at "limited spatial scale(s)" which precludes a more meaningful review of MSO habitat at ecological scales (USDI 1995). The scale of the 4FRI, and the fact it transcends administrative boundaries, allows managers to conduct a true landscape-scale analysis. Overall, about 11.5 percent (8,713 acres) of the 4FRI restricted habitat would be managed as current or future target or threshold habitat. On the Coconino NF portion of the project, where the most owls and the most MSO habitat occurs, 13 percent (6,465 acres) of the restricted layer would be designated as target or threshold habitat. The Kaibab NF portion of the 4FRI treatment area would have 8 percent (2,247 acres) of the restricted layer designated as target or threshold habitat. By creating more future nesting and roosting habitat on the Coconino NF, future MSO habitat would be more contiguous for dispersing MSOs, and occur in areas supporting higher densities of MSOs than if 10 percent of the restricted layer was designated by individual administrative boundaries (see figure 60 and figure 62).

Edited or added/new text is **bolded** in table 92.

Table 92. Alternative B Amendment 1 Current and Proposed MSO Forest Plan Language (Coconino NF)

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
MSO Standards	
No corresponding direction currently exists	**The project will comply with biological opinion that has been developed in consultation with FWS.**
Provide three levels of habitat management – protected, restricted, and other forest and woodland types to achieve a diversity of habitat conditions across the landscape (Coconino NF forest plan, p. 65)**.**	No Change
Protected areas include delineated protected activity centers; mixed conifer and pine-oak forests with slopes greater than 40% where timber harvest has not occurred in the last 20 years; and reserved lands which include wilderness, research natural areas, wild and scenic rivers, and congressionally recognized wilderness study areas (Coconino NF forest plan, p. 65)**.**	No Change
Restricted areas include all mixed-conifer, pine-oak, and riparian forests outside of protected areas (Coconino NF forest plan, p. 65).	No Change

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Other forest and woodland types include all ponderosa pine, spruce-fir, woodland, and aspen forests outside protected and restricted areas (Coconino NF forest plan, p. 65).	No Change
Survey all potential spotted owl areas including protected, restricted, and other forest and woodland types within an analysis area plus the area 1/2 mile beyond the perimeter of the proposed treatment area (Coconino NF forest plan, p. 65).	No Change
Establish a protected activity center at all Mexican spotted owl sites located during surveys and all management territories established since 1989 (Coconino NF forest plan, p. 65).	No Change
Allow no timber harvest except for firewood and fire risk abatement in established protected activity centers. For protected activity centers destroyed by fire, windstorm, or other natural disaster, salvage timber harvest or declassification may be allowed after evaluation on a case-by-case basis in consultation with U.S. Fish and Wildlife Service (Coconino NF forest plan, p. 65).	Allow no timber harvest except for firewood, fire risk abatement, in established protected activity centers **except as follows: Allow firewood, fire risk abatement, and habitat structure improvement in the following established protected activity centers: Lake No. 1/Seruchos, Archies, Red Hill, Crawdad, Holdup, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Rock Top, Lee Butte, Foxhole, Bar M, and Sawmill Spring.** For protected activity centers destroyed by fire, windstorm, or other natural disaster, salvage timber harvest or declassification may be allowed after evaluation on a case-by-case basis in consultation with U.S. Fish and Wildlife Service.
Allow no timber harvest except for fire risk abatement in mixed conifer and pine-oak forests on slopes greater than 40% where timber harvest has not occurred in the last 20 years (Coconino NF forest plan, p. 65).	No Change
Limit human activity in protected activity centers during the breeding season (Coconino NF forest plan, p. 65).	No Change
In protected and restricted areas, when activities conducted in conformance with these standards and guidelines may adversely affect other threatened, endangered, or sensitive species or may conflict with other established recovery plans or conservation agreements; consult with US Fish and Wildlife Service to resolve the conflict (Coconino NF forest plan, p. 65-1).	No Change
Monitor changes in owl populations and habitat needed for delisting (Coconino National Forest plan, page 65-1).	**See "Standards" for monitoring direction**

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Guidelines – General – No Change	
Guidelines – Protected Areas, Protected Activity Centers	
Delineate an area of not less than 600 acres around the activity center using boundaries of known habitat polygons and/or topographic features. Written justification for boundary delineation should be provided (Coconino National Forest plan, page 65-1).	No Change
The protected activity center boundary should enclose the best possible owl habitat configured in as compact a unit as possible, with the nest or activity center located near the center (Coconino National Forest plan, page 65-1).	No Change
The activity center is defined as the nest site. In the absence of a known nest, the activity center should be defined as a roost grove commonly used during breeding. In the absence of a known nest or roost, the activity center should be defined as the best nest/roost habitat (Coconino NF forest plan, p. 65-1).	No Change
Protected activity center boundaries should not overlap (Coconino NF forest plan, p. 65-1).	No Change
Submit protected activity center maps and descriptions to the recovery unit working group for comment as soon as possible after completion of surveys (Coconino NF forest plan, p. 65-1).	No Change
Road or trail building in protected activity centers should be avoided but maybe permitted on a case-by-case basis for pressing management reasons (Coconino NF forest plan, p. 65-1).	No Change
Generally allow continuation of the level of recreation activities that was occurring prior to listing (Coconino NF forest plan, p. 65-1).	No Change
Require bird guides to apply for and obtain a special use permit. A condition of the permit shall be that they obtain a subpermit under the U.S. Fish and Wildlife Service Master Endangered Species permit. The permit should stipulate the sites, dates, number of visits, and maximum group size permissible (Coconino NF forest plan, p. 65-1).	No Change
Harvest firewood when it can be done in such a way that effects on the owl are minimized. Manage within the following limitations to minimize effects on the owl (Coconino NF forest plan, p. 65-2). Retain key forest species such as oak. Retain key habitat components such as snags and large downed logs. Harvest conifers less than 9 inches in diameter only	Harvest firewood when it can be done in such a way that effects on the owl are minimized. Manage within the following limitations to minimize effects on the owl. Retain key forest species such as oak. Retain key habitat components such as snags and large downed logs. Harvest conifers less than 9 inches in diameter only

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
within those protected activity centers treated to abate fire risk as described below, except for the Clark PAC where trees less than 16 inches diameter will be harvested.	within those protected activity centers treated to abate fire risk as described below, except for the Clark PAC where trees less than 16 inches diameter will be harvested area except as follows: **Harvest conifers up to 16-inch diameter within the Lake No. 1/Seruchos, Archies, Red Hill, Crawdad, Holdup, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Rock Top, Lee Butte, Foxhole, Bar M, and Sawmill Spring PACs to abate fire risk and improve habitat structure.**
Treat fuel accumulations to abate fire risk. –Select for treatment 10% of the protected activity centers where nest sites are known in each recovery unit having high fire risk conditions. Also select another 10% of the protected activity centers where nest sites are known as a paired sample to serve as control areas (Coconino National Forest plan, page 65-2). –Designate a 100-acre “no treatment” area around the known nest site of each selected protected activity center. Habitat in the no treatment area should be as similar as possible in structure and composition as that found in the activity center. –Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark PAC), mechanical fuel treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100-acre “no treatment” area.	Treat fuel accumulations to abate fire risk. –Designate a 100-acre “no treatment” area around the known nest site of each selected protected activity center. Habitat in the no treatment area should be as similar as possible in structure and composition as that found in the activity center. – Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark PAC), mechanical treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100-acre “no treatment” area **except as follows:** **Use combinations of thinning trees up to 16-inch d.b.h. within the Lake No. 1/Seruchos, Archies, Red Hill, Holdup, Rock Top, Foxhole, Bar M, PACs, Crawdad, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Lee Butte, and Sawmill Springs PACs**, mechanical fuel treatment and prescribed fire to abate fire risk **and improve habitat structure** in the remainder of the selected protected activity center outside the 100-acre “no treatment” area.
Treat fuel accumulations to abate fire risk. Pre- and post-treatment monitoring should be conducted in all protected activity centers treated for fire risk abatement. (See monitoring guidelines) (Coconino National Forest plan, page 65-2).	**–See “Standards” for Monitoring Direction**
Steep Slopes (Mixed conifer and pine-oak forests outside protected activity centers with slopes greater than 40% that have not been logged within the past 20 years): No seasonal restrictions apply.	
Treat fuel accumulations to abate fire risk. –Use combinations of thinning trees less than 9 inches in diameter, mechanical fuel removal, and prescribed fire. –Retain woody debris larger than 12 inches in diameter, snags, clumps of broadleafed woody vegetation, and hardwood tress larger than 10 inches in diameter at the root collar.	Treat fuel accumulations to abate fire risk. –Use combinations of thinning trees less than 9 inches in diameter, mechanical fuel removal, and prescribed fire. –Retain woody debris larger than 12 inches in diameter, snags, clumps of broadleafed woody vegetation, and hardwood tress larger than 10 inches in diameter at the

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
– Pre and post treatment monitoring should occur within all steep slopes treated for fire risk abatement. (See monitoring guidelines).	root collar. **–See "Standards" for Monitoring Direction**
Reserved Lands (Wilderness, Research Natural Areas, Wild and Scenic Rivers, and Congressionally Recognized Wilderness Study Areas): Allow prescribed fire where appropriate – No change.	
Restricted Areas (Mixed conifer, pine-oak, and riparian forests)	
No corresponding direction	**Target habitat is a category of restricted habitat intended to provide future nesting and roosting habitat (see glossary definition for restricted habitat). The minimum values identified for the forest attributes represent the threshold for meeting nesting and roosting conditions (see the definition for threshold habitat). They can also be targets to be achieved with time and management. If less than 10 percent of the restricted habitat in ponderosa pine-Gambel oak qualifies as threshold habitat, the areas that can eventually achieve all threshold conditions simultaneously should be identified as target habitat and managed to achieve threshold conditions as rapidly as possible. Because no known nests or roosts occur in restricted habitat, target habitat is considered future nesting and roosting habitat.**
No corresponding direction	**Threshold habitat is a category of restricted habitat intended to provide for future nesting and roosting habitat (see definition for restricted habitat). A variety of forest structural attributes is used to define when nesting and roosting habitat is achieved (summarized in table III.B.1 of the 1995 recovery plan and table C-2 of the 2012 recovery plan). Threshold habitat meets or exceeds these values. When the minimum values identified for the forest attributes are met simultaneously, they represent the threshold of nesting and roosting conditions. Up to 10 percent of restricted habitat in ponderosa pine-Gambel oak should be designated as threshold habitat. Management in threshold habitat cannot lower any of the forest attribute values below the nesting and roosting threshold unless a landscape analysis demonstrates an abundance of this habitat. Because no known nests or roosts occur in restricted habitat, target habitat is managed as future nesting and roosting habitat.**
Mixed Conifer and Pine-oak Forests (see glossary definition): Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species. The following table displays	Mixed Conifer and Pine-oak Forests (See glossary definition): Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species. The following table displays

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
the minimum percentage of restricted area which should be managed to have nest/roost characteristics. The minimum mixed conifer restricted area includes 10% at 170 basal area and an additional amount of area at 150 basal area. The additional area of 150 basal area is +10% in BR-E and +15% in all other recovery units. The variables are for stand averages and are minimum threshold values and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum threshold values should be reduced below the threshold values unless a districtwide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting the threshold values. Management should be designed to create minimum threshold conditions on project areas where there is a deficit of stands simultaneously meeting minimum threshold conditions unless the districtwide or larger landscape analysis shows there is a surplus. This table has been modified to contain only information pertinent to the Coconino NF. (Coconino NF forest plan, pp. 65-3 to 65-5).	the minimum percentage of restricted area which should be managed to have nest/roost characteristics. The minimum mixed conifer restricted area includes up to 10 percent at 170 basal area and an additional amount of area at 150 basal area. The additional area of 150 basal area is +10 percent in BR-E and +15 percent in all other recovery units. **In pine-oak, the minimum restricted area includes up to 10 percent at 150 basal area.** The variables are for stand averages, are minimum **target and** threshold **habita**t values, and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum **target and** threshold **habita**t values should be reduced below **target and** threshold values unless a districtwide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting **target and** threshold values. Management should be designed to create minimum **target and** threshold **habitat** conditions on project areas where there is a deficit of stands simultaneously meeting minimum **target and** threshold **habitat** conditions unless the districtwide or larger landscape analysis shows there is a surplus. This table has been modified to contain only information pertinent to the Coconino NF.

Variable	Mixed Conifer All RU	Mixed Conifer Other RU*	Pine-Oak Target and Threshold Habitat**
Restricted Area %	10%	+15%	**Up to** 10%
Stand Averages for:			
Basal Area	170	150	150
18 inch+ trees/acre	20	20	20
Oak Basal Area	NA	NA	20
Percent total existing:			
12–18”	10	10	15
18–24”	10	10	15
24+”	10	10	15

Attempt to mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes, into management prescriptions (Coconino National Forest plan, page 65-4).	No Change
Maintain all species of native trees in the landscape including early seral species (Coconino National Forest plan, page 65-4).	No Change

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Allow natural canopy gap processes to occur, thus producing horizontal variation in stand structure (Coconino National Forest plan, page 65-4).	No Change
Emphasize uneven-aged management systems. However, both even-aged and unevenaged systems may be used where appropriate to provide variation in existing stand structure and species diversity. Existing stand conditions will determine which system is appropriate (Coconino National Forest plan, page 65-4).	No Change
Extend rotation ages for even-aged stands to greater than 200 years. Silvicultural prescriptions should explicitly state when vegetative manipulation will cease until rotation age is reached (Coconino National Forest plan, page 65-4).	No Change
Save all trees greater than 24 inches d.b.h. In pine-oak forests, retain existing large oaks and promote growth of additional large oaks (Coconino National Forest plan, page 65-4).	No Change
In pine-oak forests, retain existing large oaks and promote growth of additional large oaks (Coconino National Forest plan, page 65-4).	No Change
Encourage prescribed and prescribed natural fire to reduce hazardous fuel accumulation. Thinning from below may be desirable or necessary before burning to reduce ladder fuels and the risk of crown fire (Coconino National Forest plan, page 65-4).	No Change
Retain substantive amounts of key habitat components: • Snags 18 inches in diameter and larger • Down logs over 12 inches midpoint diameter • Hardwoods for retention, recruitment, and replacement of large hardwoods	No Change
Riparian Areas – No Change	
Domestic Livestock Grazing – No Change	
Old-Growth – No Change	
Other Forest and Woodland Types – No Change	
Guidelines for Specific Recovery Units – No Change	

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Monitoring Guidelines	
Monitoring and evaluation should be collaboratively planned and coordinated with involvement from each national forest, USFWS Ecological Services Field Office, USFWS Regional Office, USFS Regional Office, Rocky Mountain Research Station, recovery team, and recovery unit working groups.	**See "Standards" for Monitoring Direction**
Population monitoring should be a collaborative effort with participation of all appropriate resource agencies. (Coconino National Forest plan, page 65-6).	
Habitat monitoring of gross habitat changes should be a collaborative effort of all appropriate resource agencies. (Coconino National Forest plan, page 65-6).	
Habitat monitoring of treatment effects (pre- and post-treatment) should be done by the agency conducting the treatment. (Coconino National Forest plan, page 65-6).	
Prepare an annual monitoring and evaluation report covering all levels of monitoring done in the previous year. The annual report should be forwarded to the regional forester with copies provided to the recovery unit working groups, USFWS Ecological Services field offices, and the USFWS Regional Office (Coconino National Forest plan, page 65-6).	
Rangewide: Track gross changes in acres of owl habitat resulting from natural and human-caused disturbances. Acreage changes in vegetation composition, structure, and density should be tracked, evaluated, and reported. Remote sensing techniques should provide an adequate level of accuracy. (Coconino National Forest plan, page 65-6) In protected and restricted areas where silvicultural or fire abatement treatments are planned, monitor treated stands pre- and post-treatment to determine changes and trajectories in fuel levels; snag basal areas; live tree basal areas; volume of down logs over 12 inches in diameter; and basal area of hardwood trees over 10 inches in diameter at the root crown (Coconino National Forest plan, page 65-6).	

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Upper Gila Mountain, Basin and Range East, and Basin and Range West Recovery Units: Assist the recovery team and recovery unit working groups to establish sampling units consisting of 19 to 39 square mile quadrats randomly allocated to habitat strata. Quadrats should be defined based on ecological boundaries such as ridge lines and watersheds. Quadrat boundaries should not traverse owl territories. Twenty percent of the quadrats will be replaced each year at random. Using the sample quadrats, monitor the number of territorial individuals and pairs per quadrat; reproduction; apparent survival; recruitment; and age structure. Track population density both per quadrat and habitat stratum.	**See "Standards" for Monitoring Direction**

* Edited text is **bolded.**

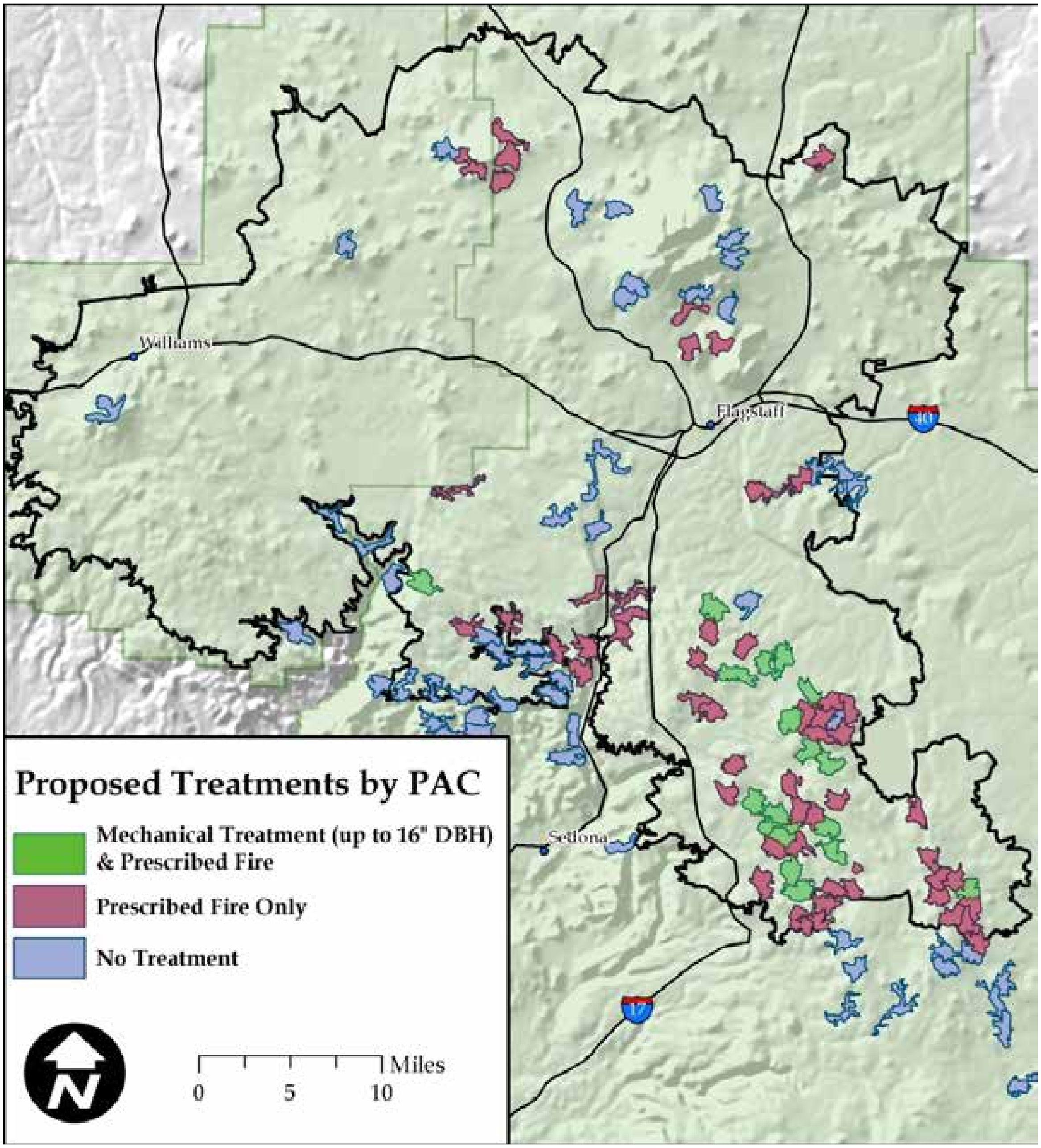

Figure 50. Alternative B amendment 1 MSO PAC treatments

Consistency with the MSO Recovery Plan

The 1995 recovery plan (USDI 1995), which was incorporated into the current forest plans states "Two primary reasons were cited for the listing: historical alteration of its habitat as the result of timber management practices, specifically the use of even-aged silviculture…" and "The danger of catastrophic wildfire…" While the recovery plan is clear that the primary existing threat is high-severity wildland fire, the recovery plan also states that "[r]etaining large trees is desirable because they are impossible to replace quickly and because they are common features of nesting and roosting habitats for the owl." The recovery plan recognizes that "ecosystems are temporally dynamic [and] provisions are needed to ensure owl habitat in the long term." The primary objective to be achieved by the recovery plan guidelines is protection of the best available habitat for the MSO, while maintaining sufficient flexibility for land managers to abate high fire risks and to improve habitat conditions for the owl and its prey (page 89). The potential for using silviculture as a tool for meeting objectives such as maintaining and developing MSO habitat and enhancing various ecological factors is specifically identified in the recovery plan.

The 1995 recovery plan recommends that recovery efforts concentrate on the recovery units with the highest owl populations and where significant threats exist. The project is located within the Upper Gila Mountain Recovery Unit (UGM RU). The UGM RU contains the largest known number of MSOs with approximately 55 percent of known spotted owl territories. The major land use within this recovery unit has been timber harvest.

The 1995 recovery plan describes a change in the size class distribution of trees that occurred on commercial forest lands in Arizona and New Mexico between the 1960s and 1980s. The density of large trees (greater than 19-inch d.b.h.) decreased by 20 percent and sapling-sized trees (1- to 4.9-inch d.b.h.) decreased in both absolute density and in relative contribution to the size class distribution. Trees 5- to 12.9-inch d.b.h. increased in density by 40 percent and in relative proportion of the size class distribution and trees 13- to 19-inch d.b.h. increased in density but not in the relative proportion of the tree distribution. The decrease in large trees was described as "an alarming negative trend with respect to a very critical component of spotted owl habitat" (page 68) given that "the basis to maintain owl populations is to ensure that adequate habitat quality and quantity will be sustained through time." In order to achieve this, the 1995 recovery plan advocates using coarse and fine filters for ecosystem management.

Coarse filters should be used "to maintain the natural array of conditions that exist with the biotic and physical limits of the landscape" while fine filters may be used "to provide specialized habitats or habitat elements within that overall landscape." They recommend "innovative applications of uneven-aged management" for developing and maintaining important but difficult to replace spotted owl habitat elements, including large pine and oak trees and key habitat components, such as trees greater than 24-inch d.b.h. and prey habitat. The amendment allows for using silvicultural treatments in 18 PACs at risk of losing key MSO habitat elements through declining forest health. Treatment objectives in the 18 PACs are to develop and maintain adequate MSO habitat quality and quantity through time.

The need to evolve from managing solely for firewood collection and fire risk abatement is reflected in the revised 2012 recovery plan. In the revised plan, the FWS states, "Management recommendations are most conservative within PACs, but by no means advocate a "hands-off" approach. The recovery team recognizes situations exist where management is needed to sustain or enhance desired conditions for the owl, including fire-risk reduction, as well as monitoring owl response. Mechanical treatments in some PACs may be needed to achieve these objectives; determining which PACs may benefit from mechanical treatments requires a landscape analysis to determine where the needs of fire risk reduction and habitat enhancement are greatest. " (USDA 2012, page VIII) which is the process we are currently undergoing.

The plan amendment would require monitoring to occur as outlined in the project's biological opinion from the FWS. Following the current forest plan direction would have resulted in few PACs being treated during the life of the project. Current plan direction suspends treatments until monitoring of the initial sample shows there are no negative impacts, or negative impacts are mitigated by modifying treatments. Following this direction could delay implementation for years, potentially decades' if changes in populations had to be documented before additional treatments were implemented. Following the current forest plan direction would have resulted in few PACs being treated with the objective of fire-risk reduction or improving condition for the owl during the life of the project.

The deviation from selecting PACs and monitoring in 10 percent increments is consistent with the new MSO recovery plan. The plan amendment would require monitoring to occur as outlined in the project's biological opinion from the FWS.

Significance Evaluation

Per FSM 1926.51, changes to the land management plan that are not significant can result from:

1. Actions that do not significantly alter the multiple-use goals and objectives for long-term land and resource management.
2. Adjustments of management area boundaries or management prescriptions resulting from further onsite analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long-term land and resource management.
3. Minor changes in standards and guidelines.
4. Opportunities for additional projects or activities that will contribute to achievement of the management prescription.

Per FSM 1926.52, circumstances that may cause a significant change to a land management plan include:

1. Changes that would significantly alter the long-term relationship between levels of multiple-use goods and services originally projected (see section 219.10(e) of the planning regulations in effect before November 9, 2000 (see 36 CFR parts 200 to 299, revised as of July 1, 2000)), and
2. Changes that may have an important effect on the entire land management plan or affect land and resources throughout a large portion of the planning area during the planning period.

Analysis demonstrated that the proposed amendment is nonsignificant (FSM 1926.51) because the actions would not measurably alter the multiple-use goals and objectives for long term land and resource management. How actions could potentially affect timing, location, and size, relationship to forest goals, objectives, outputs, and management prescriptions was evaluated.

Timing: In terms of timing, the forest plan has been in place and amended several times since 1987, and revision efforts are underway. The forest plan incorporated direction (via an amendment) from the Forest Service Southwestern Region's 1996 "Amendment of Forest Plans Record of Decision" (USDA 1996). The actions allowed via the amendment are consistent with existing forest plan direction in that it improves nesting and rooting habitat, reduces the risk of loss from fire, and will comply with the site-specific treatment and monitoring requirements in the FWS biological opinion. Forest plan direction may be amended to incorporate the revised MSO recovery plan (USDI 2012) which recognizes that habitat restoration, in addition to the reduction of fire risk, is key to improving habitat quality.

Location and Size: There are 168 MSO PACs occurring entirely on the Coconino NF. The amendment would affect 18 (11 percent) of all Coconino NF PACs. There is approximately 117,636 acres of MSO PACs on the Coconino NF. Approximately 35,566 acres of PAC habitat occurs within the project area. The amendment would affect 7,353 acres or 21 percent of the PAC habitat in the project area and approximately 6 percent of the total PAC habitat on the forest. Work would be accomplished incrementally over a 10-year period. On average, less than 1,000 acres of PAC habitat would be treated per year. This is expected to balance the need to reduce the risk of crown fire while allowing for monitoring and feedback loops that would allow management to be adaptive. On the Coconino NF portion of the project—where the most owls and the most MSO habitat occurs—13 percent (6,465 acres) of the restricted layer would be designated as target or threshold habitat.

Relationship to Forest Goals and Objectives: The amendment is consistent with forest plan goals for wildlife and fish of managing habitat to maintain viable populations of wildlife and fish species and improve habitat for selected species (Coconino National Forest plan, replacement page 22-1) and to improve habitat for listed threatened, endangered, or sensitive species of plants and animals and other species as they become threatened or endangered (Coconino National Forest plan, replacement page 23). The amendment is consistent with goals and objectives by protecting conditions and structures used by spotted owls where they exist and to set other stands on a trajectory to grow into replacement nest habitat or to provide conditions for foraging and dispersal (USDI 2012).

The amendment removes language that addresses pre- and post-treatment, population, and habitat monitoring and replaces it with language that focuses on implementing the requirements in the FWS biological opinion for this project. Delaying treatment in PACs would leave occupied MSO habitat at risk of loss from high-severity fire. Arizona's two largest fires account for nearly a million and half acres of forested land burned since 2002. Both fires included high-severity fire in PAC habitat. Other fires in the Upper Gila Recovery Unit have charred additional acres of MSO protected habitat. Most climate models suggest that the Southwest will experience higher temperatures and increased variability in precipitation, which will significantly affect fire regimes and forest health (Aumack et al. 2007).

The FWS urges a deliberate and cautious approach to management activities within PACs (USDI 2012). Silvicultural modeling of the proposed treatments indicates limited change to forest structure after implementation. However, the treatments are expected to include increased tree growth rates to reduce the time needed for developing large trees (defined as 18-inch d.b.h. and greater in the current recovery plan for the MSO), maintaining existing large trees, and decreasing surface fuels and increasing crown base height. Combined, this should develop and maintain MSO nesting and roosting habitat, a key aspect of the MSO recovery plan, while decreasing risk of crown fire.

Forest restoration and fuel reduction treatments would be evaluated over time. Through formal consultation with FWS, we expect that monitoring would be designed and implemented to evaluate the effects of prescribed fire and hazardous fuel reduction treatments on spotted owl habitat, and to retain or move toward MSO desired future conditions, as described in the recovery plan. The details on accomplishing the monitoring goals will be developed specifically through coordination with the FWS under formal consultation, as described in the ESA. In this way, work to protect and improve PAC habitat can be accomplished in a timely manner while emphasizing monitoring and feedback loops to allow management to be adaptive. For these reasons, the amendment as it relates to pre- and post-treatment, population, and habitat monitoring is consistent with forest plan goals and objectives.

Designating target or threshold habitat in the project with the best potential would move toward desired percentages in restricted (recovery) habitat, consistent with forest plan goals and objectives.

Relationship to Management Prescriptions: Table 93 displays the forestwide management area acres that would be affected. The amendment would affect about 5,359 acres (1 percent) of MA 3 and about 1,773 acres (3 percent) of MA 35. Acres within other MAs (MA 4, MA 10, MA 5, MA 9, MA 12, and MA 6) are minor, totaling 221 acres.

The amendment intent is consistent with the management emphasis in MA 3 and MA 35 which stresses improving and maintaining the quality of the habitat (MA 3) and moving ponderosa pine toward the desired forest structure, including northern goshawk and MSO habitats (MA 35). The amendment would not impose requirements on future management of MSO PACs as the amendment is site specific to this analysis and only addresses current conditions within protected habitat.

Table 93. Alternative B amendment 1 management area acres (Coconino NF)

MA	MA Description	Forestwide Acres	Proposed Amendment Acres	Forestwide Acres Affected (Percent)
MA 3	Ponderosa Pine Below 40 Percent Slopes	511,015	5,359	1
MA 35	Lake Mary Watershed	62,536	1,773	3
MA 4, 10, 5, 9, 12, and 6	See chapter 1, table 14	307,011	221	<1

Relationship to Outputs: Outputs identified in the forest plan are associated with million board feet (MMBF) of sawtimber sales and products (meet demand for timber while reducing conflict with other resources), MMBF of firewood sold and free use (provide access to firewood), grazing capacity (MAUM), and permitted livestock use (MAUM). Due to the minimal acres affected, the amendment would not alter outputs on a forestwide basis or change the long-term relationship between levels of goods (timber, firewood) and services.

In comparison to the forest's total suitable timber lands (626,326 acres), the amendment affects about 1 percent of those lands. For this reason, treatments within PACs do not measurably increase or decrease timber outputs or firewood availability. Treatment within PACs would not affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use. There would be no measurable effect to outputs on a forestwide basis or the long-term relationship between levels of goods (timber, firewood) and services from managing restricted habitat up to 10 percent or deferring the final design of treatments and monitoring to the project's biological opinion.

Amendment 2. Management of Canopy Cover and Ponderosa Pine with an Open Reference Condition within Goshawk Habitat (Coconino NF)

Amendment 2 is a specific, one-time variance for the Coconino NF portion of the restoration project. Once the project is complete, current forest plan direction would apply to the project area. The language proposed does not apply to any other forest project. The amendment would be authorized per direction in the National Forest Management Act of 1976 (NFMA) and its implementing regulations found in 36 CFR 219 (1982).

Amendment Description

In the “Vegetation Management – Landscapes Outside Goshawk Post-fledgling Family Areas” and “Vegetation Management –Within Post-fledgling Family Areas” section of the forest plan, a site-specific, nonsignificant plan amendment would: (1) add the desired percentage of interspace within uneven-aged stands to facilitate restoration, (2) add the interspace distance between tree groups, (3) add language clarifying where canopy cover is and is not measured, (4) allow 29,017 acres to be managed for an open reference condition (which affects canopy cover guidelines for VSS 4 through VSS 6 groups and reserve trees), and (5) add a definition to the forest plan glossary for the terms interspaces, open reference condition, and stands. Edited or added/new text is **bolded** in the “Proposed New Guideline Language” column in table 94.

The forest plan directs projects to manage for uneven-aged stand conditions within goshawk habitat. Forested groups consist of an interspersion of six vegetation structural stages (VSS 1 to VSS 6). For the purposes of this amendment, the following definitions apply:

- **Stands** are defined as a contiguous area of trees sufficiently uniform in forest type, composition, structure, and age class distribution, growing on a site of sufficiently uniform conditions to be a distinguishable unit. Four classification characteristics are generally used to distinguish forest stands: biophysical site (soils, aspect, elevation, plant community association, climate, etc.), species composition, structure (density, and age (1-aged, 2-aged, uneven-aged)), and management emphasis (administrative requirements and local management emphasis that will shape structure over time). Based upon Agency guidelines, the minimum stand mapping size is 10 acres.
- **Interspaces** are defined as the open space between tree groups intended to be managed for grass/forb/shrub vegetation during the long term. Interspaces may include scattered single trees.
- **Open reference condition** is defined as forested ponderosa pine areas with mollic-integrade soils to be managed as a relatively open forest with trees typically aggregated in small groups within a grass/forb/shrub matrix.

Background

Canopy cover is defined as “the percentage of a fixed area covered by the crowns of plants delimited by a vertical projection of the outermost perimeter of the spread of foliage” (Reynolds et al. 1992). Obtaining consistent results has been difficult; even the definition of the term is dependent on the method of measurement. To resolve this issue, the Forest Service used the Forest Vegetation Simulation (FVS) crown width model as the basis for developing stocking densities that would achieve desired canopy cover levels.

The forest plan directs projects to measure “vertical crown projection on average across the landscape” (see Coconino National Forest plan, page 65-9). Whereas the forest plan clearly provides direction for meeting minimum canopy cover percentages in VSS 4 to 6, the plans lack explicit language for measuring canopy cover. Although the forest plan provides direction and desired conditions for the vegetation structural stages, the forest plan does not describe the relationship between nonforested areas (interspace) and natural openings across the landscape. Figure 51 displays general locations of goshawk habitat that is subject to canopy cover requirements in VSS 4 through VSS 6 on the forests.

Nonforested areas (interspaces) occur between individual trees, tree clumps, and tree groups. These nonforested areas (interspaces) are not equivalent to VSS 1. Whereas VSS 1 may provide openings in the short term, this structural stage is expected to regenerate tree cover in the long term. Refer to the silviculture report and the mplementation plan (appendix D) which provides minimum stocking guidelines that have been developed to assure canopy cover requirements are met.

Approximately 198,136 acres (61 percent) of the forested areas (within the project area) have an open reference condition that corresponds to mollic-integrade soils. The desired condition is to have a portion of these acres (29,017 acres) managed as a relatively open forest with trees typically aggregated in small groups within a grass/forb/shrub matrix (Woolsey 1911, Cooper 1960, White 1985, Pearson 1950, Covington et a1.1997, Abella and Denton 2009). See the soils specialist report for detailed information. Figure 52 displays the location of acres that would be managed for an open reference condition.

Table 94. Alternative B Amendment 2 Management of Canopy Cover and Ponderosa Pine with an Open Reference Condition in Goshawk Habitat (Coconino NF)

Current Coconino NF Forest Plan Direction	Proposed New Guideline Language*
Landscapes Outside Goshawk Post-fledgling Family Areas	
No similar direction in forest plan	**General: Within ponderosa pine stands, manage over time for uneven-aged stand conditions composed of heterogeneous mosaics of tree groups and single trees, with interspaces between tree groups. The size of tree groups, as well as sizes and shapes of interspaces, should be variable. Over time, the spatial location of the tree groups and interspaces may shift within the uneven-aged stand.**
General: The distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir forests is 10% grass/forb/shrub (VSS 1), 10% seedling-sapling (VSS 2), 20% young forest (VSS 3), 20% mid-aged forest (VSS 4), 20% mature forest (VSS 5), 20% old forest (VSS 6). NOTE: The specified percentages are a guide and actual percentages are expected to vary + or – up to 3% (Coconino NF forest plan, p. 65-9).	General: **For the areas managed for tree crown development**, the distribution of vegetation structural stages for ponderosa pine, mixed conifer, and spruce-fir forests is 10 percent grass/forb/shrub (VSS 1), 10 percent seedling-sapling (VSS 2), 20 percent young forest (VSS 3), 20 percent mid-aged forest (VSS 4), 20 percent mature forest (VSS 5), and 20 percent old forest (VSS 6). Note: the specified percentages are a guide and actual percentages are expected to vary plus or minus up to 3 percent.
The distribution of VSS, tree density, and tree age are a product of site quality in the ecosystem management area. Use site quality to guide in the	No change

Current Coconino NF Forest Plan Direction	Proposed New Guideline Language*
distribution of VSS, tree density and tree ages. Use site quality to identify and manage dispersal PFA and nest habitat at 2–2.5 mile spacing across the landscape (Coconino NF forest plan, p. 65-9).	
Snags are 18" or larger d.b.h. and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape (Coconino NF forest plan, p. 65-9).	Snags are 18" or larger d.b.h. and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, **canopy cover as defined by vertical crown projection is evaluated within mid-aged to old forest vegetation structural stage groups (VSS 4, 5, and 6).**
No corresponding forest plan direction	**Develop and maintain a highly diverse vegetation mosaic: 30 to 90 percent of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns. Within areas managed for an open reference condition, 10 to 30 percent of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns.**
No corresponding forest plan direction	**Tree group spatial distribution may be highly variable based on local site and current conditions; the interspaces between groups may range from 20 to 200 feet, but generally between 25 and 100 feet apart from drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.**
No corresponding forest plan direction	**Each tree group is generally dominated by one vegetation structure stage. The spatial arrangement of trees, high dispersion of VSS structural stage diversity, and interspaces comprise each uneven-aged forest stand. Collectively these stands aggregate to uneven-aged forest landscapes, similar to natural conditions.**
The order of preferred treatment for woody debris is: (1) prescribed burning, (2) lopping and scattering, (3) hand piling or machine grapple piling, (4) dozer piling (Coconino NF forest plan, p. 65-9).	No Change
Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stages (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stages (VSS 1, VSS 2, and VSS 3) (Coconino NF forest plan, p. 65-9).	Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stage **groups** (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stage **groups** (VSS 1, VSS 2, and VSS 3) **or in interspaces, natural meadows, grasslands, or other areas not managed for forest cover.**
Spruce-Fir: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60% and 2/3 40%, mature forest (VSS 5) should average 60+%, and old forest (VSS 6) should average 60+%. Maximum opening size is 1 acre with a maximum width of 125 feet. Provide 2 groups of reserve trees per acre with 6 trees per group when opening size exceeds 0.5. Leave at least 3 snags, 5 downed logs, and 10–15 tons of woody debris per acre (Coconino NF forest plan, p. 65-9).	No Change

Current Coconino NF Forest Plan Direction	Proposed New Guideline Language*
Mixed Conifer: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 40+%, mature forest (VSS 5) should average 50+%, and old forest (VSS 6) should average 60+%. Maximum opening size is up to 4 acres with a maximum width of up to 200 feet. Retain 1 group of reserve trees per acre of 3–5 trees per group for openings greater than 1 acre in size. Leave at least 3 snags, 5 downed logs, and 10–15 tons of woody debris per acre (Coconino NF forest plan, p. 65-10).	No Change
Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5) should average 40+%, and old forest (VSS 6) should average 40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3–5 trees per group, will be left if the opening is greater than an acre in size. Leave at least 2 snags per acre, 3 downed logs per acre, and 5–7 tons of woody debris per acre (Coconino NF forest plan, p. 65-10).	Ponderosa Pine: Canopy cover for mid-aged forest (VSS 4) should average 40+ percent, mature forest (VSS 5) should average 40+ percent, and old forest (VSS 6) should average 40+ percent. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, three to five trees per group, will be left if the **created regeneration** opening is greater than an acre in size. Leave at least two snags per acre, three downed logs per acre, and 5 to 7 tons of woody debris per acre. **In acres managed for an open reference condition, canopy cover guidelines for VSS 4 through VSS 6 groups do not apply. One group of reserve trees, with a minimum of one to two trees per group will be left if the interspace size is greater than an acre in size. Interspace size is up to 4 acres.** Leave at least two snags per acre, three downed logs per acre, and 5 to 7 tons of woody debris per acre
Woodland: manage for uneven-age conditions to sustain a mosaic of vegetation densities (overstory and understory), age classes, and species composition well distributed across the landscape. Provide for reserve trees, snags, and down woody debris (Coconino NF forest plan, p. 65-10).	No Change
Vegetation Management – Within Post-fledgling Family Areas	
General: Provide for a healthy sustainable forest environment for the post-fledging family needs of goshawks. The principle difference between within the post-fledging family area and outside the post-fledging family area is the higher canopy cover within the post-fledging family area and smaller opening size within the post-fledging family area. Vegetative structural stage distribution and structural conditions are the same within and outside the post-fledgling family area (Coconino NF forest plan, p. 65-10).	No Change

Current Coconino NF Forest Plan Direction	Proposed New Guideline Language*
No similar direction in forest plan	**Canopy cover is evaluated at the group level within mid-aged to old forest structural stages groups (VSS 4, VSS 5, and VSS 6) and not within grass/forb/shrub to young forest structural stage groups (VSS 1, VSS 2, and VSS 3) or in interspaces, natural meadows and grasslands, or other areas not managed for forest conditions.**
Spruce-fir: Canopy Cover for mid-aged forest (VSS 4) should average 60+% and for mature (VSS 5) and old forest (VSS 6) should average 70+% (Coconino NF forest plan, p. 65-10).	No Change
Mixed Conifer: Canopy Cover for mid-aged (VSS 4) to old forest (VSS 6) should average 60+%.	No Change
Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 50+%. Mature (VSS 5) and old forest (VSS 6) should average 50+% (Coconino NF forest plan, p. 65-10).	No Change
No corresponding forest plan direction	**Develop and maintain a highly diverse vegetation mosaic: 30 to 90 percent of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns.**
No corresponding forest plan direction	**Tree group spatial distribution may be highly variable based on local site and current conditions; the interspaces between groups may range from 20 to 200 feet, but generally between 25 and 100 feet apart from drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.**
No corresponding forest plan direction	**Each tree group is generally dominated by one vegetation structure stage. The spatial arrangement of trees, high dispersion of vegetation structural stage diversity, and interspaces comprise each uneven-aged forest stand. Collectively these stands aggregate to uneven-aged forest landscapes, similar to natural conditions.**
Glossary	
No corresponding forest plan language	**Interspaces: The open space between tree groups intended to be managed for grass/forb/shrub vegetation during the long term. Interspaces may include scattered single trees.**
No corresponding forest plan language	**Open reference condition: Forested ponderosa pine areas with mollic-integrade soils to be managed as a relatively open forest with trees typically aggregated in small groups within a grass/forb/shrub matrix.**
No corresponding forest plan language	**Stands: Contiguous area of trees sufficiently uniform in forest type, composition, structure, and age class distribution, growing on a site of sufficiently uniform conditions to be a distinguishable unit.**

* Edited and new/added text is **bolded.**

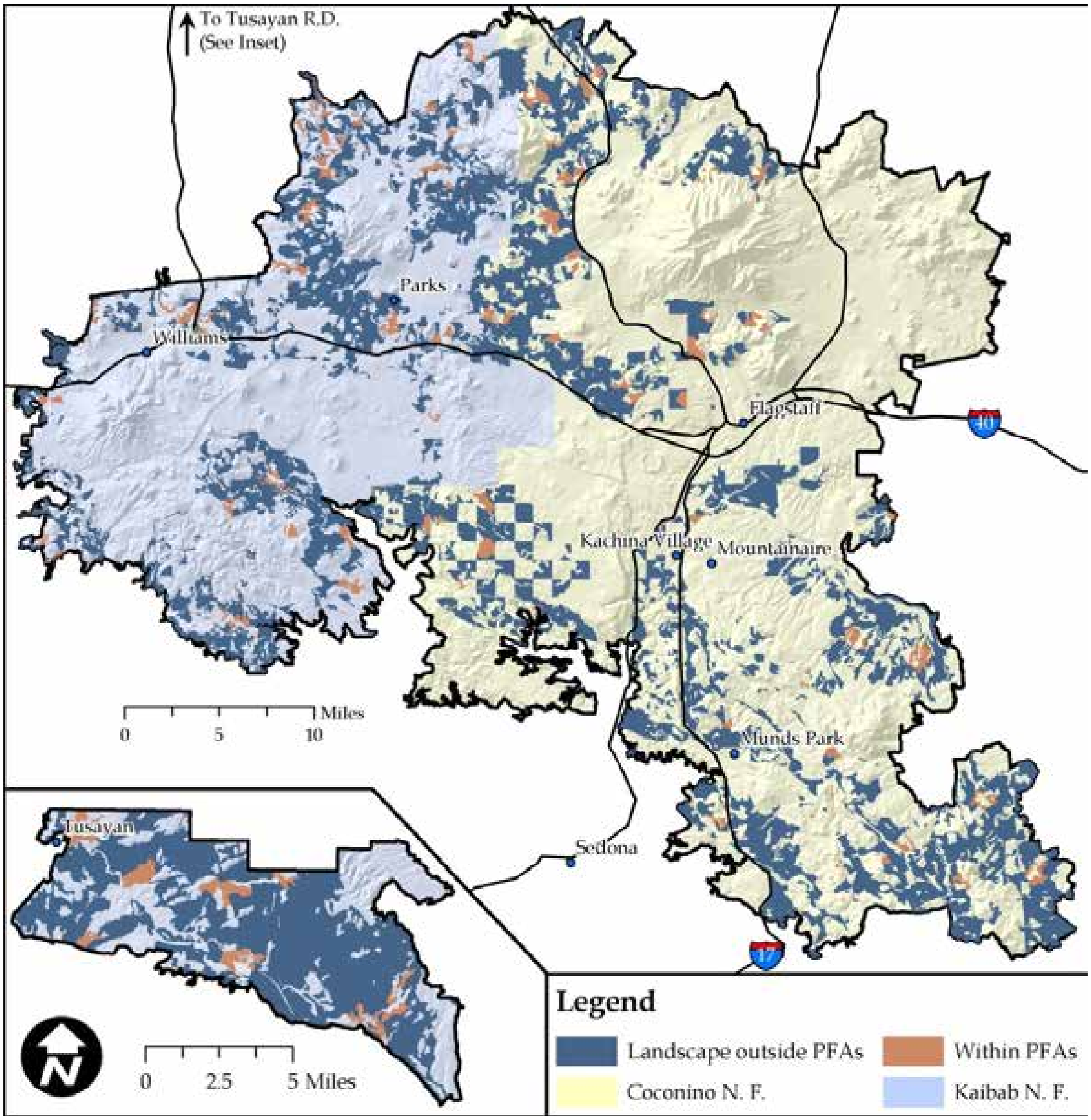

Figure 51. Alternative B goshawk habitat subject to canopy cover requirements in VSS 4 and VSS 6 (Coconino and Kaibab NF)

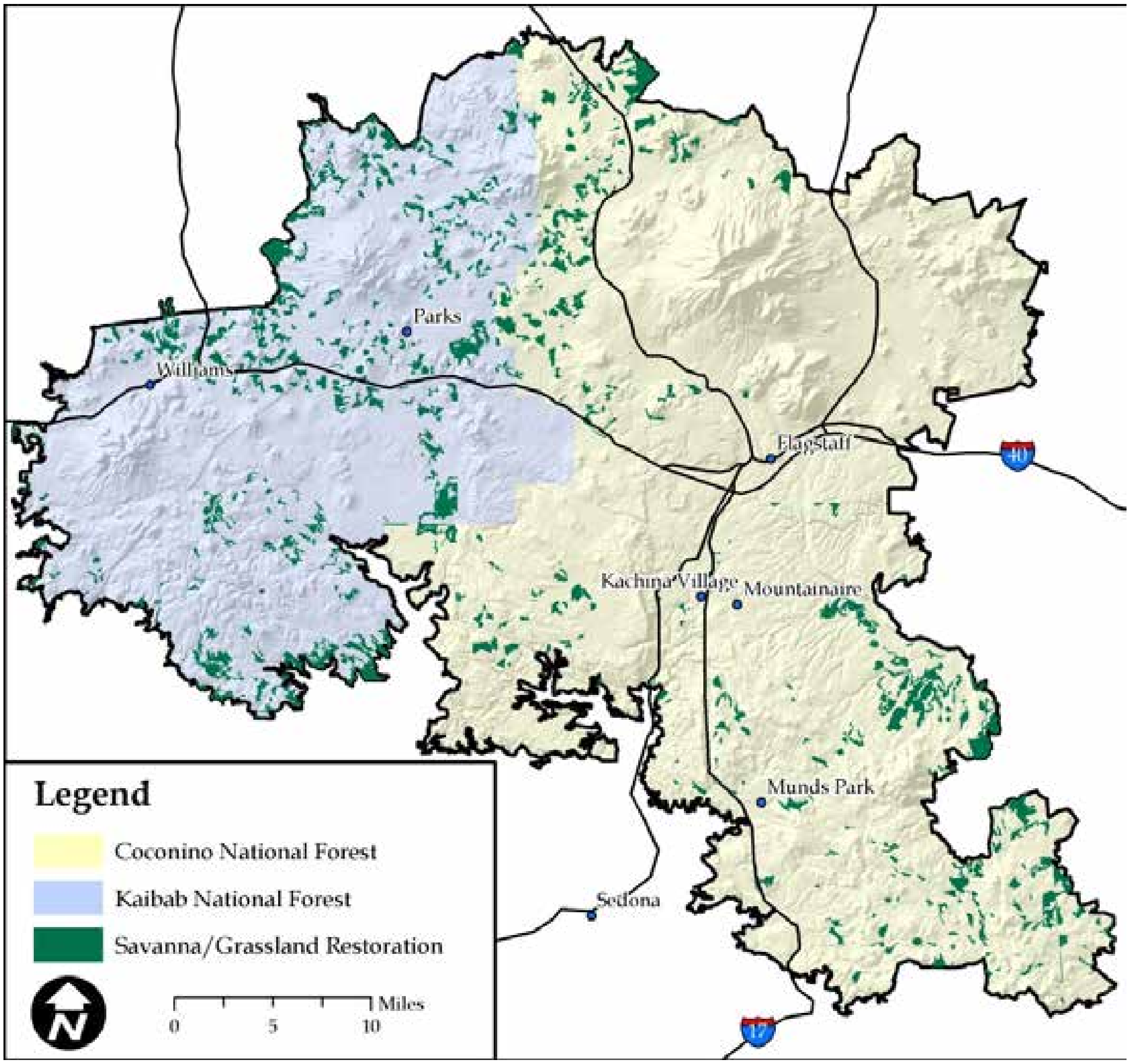

Figure 52. Alternative B general locations of savanna and grassland restoration treatments (Coconino NF and Kaibab NF)

Significance Evaluation

Per FSM 1926.51, changes to the land management plan that are not significant can result from:

1. Actions that do not significantly alter the multiple-use goals and objectives for long term land and resource management.
2. Adjustments of management area boundaries or management prescriptions resulting from further onsite analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long term land and resource management.
3. Minor changes in standards and guidelines.
4. Opportunities for additional projects or activities that will contribute to achievement of the management prescription.

Per FSM 1926.52, circumstances that may cause a significant change to a land management plan include:

1. Changes that would significantly alter the long-term relationship between levels of multiple-use goods and services originally projected (see section 219.10(e) of the planning regulations in effect before November 9, 2000 (see 36 CFR parts 200 to 299, revised as of July 1, 2000)), and
2. Changes that may have an important effect on the entire land management plan or affect land and resources throughout a large portion of the planning area during the planning period.

Analysis demonstrated that the proposed amendment is nonsignificant (FSM 1926.51) because the actions would not measurably alter the multiple-use goals and objectives for long term land and resource management and the actions. How actions could potentially affect timing, location and size, relationship to forest goals, objectives, outputs, and management prescriptions was evaluated.

Timing: In terms of timing, the forest plan has been in place (and amended) since 1987 and plan revision efforts are underway.

Location and Size: Suitable goshawk habitat on the Coconino NF encompasses about 791,897 acres (Green 2011, draft unpublished data). Approximately 399,633 acres of goshawk habitat is within the 4FRI project area.

- The canopy cover portion of the amendment would affect 139,308 acres (18 percent) of all goshawk habitat on the Coconino NF and about 35 percent of goshawk habitat within the project area. For this reason, location (confined to the ponderosa pine cover type) and size was determined to be nonsignificant.
- Managing 29,017 acres of ponderosa pine for an open reference condition would affect approximately 4 percent of all suitable goshawk habitats on the forest and about 8 percent of goshawk habitat within the project area.

For these reasons, location and size was determined to be nonsignificant. The amendment would facilitate moving over 139,000 acres toward the desired forest structure (tree groups and herbaceous openings) that maximizes prey base species habitat and allows for reintroduction of fire into the ecosystem; and moves over 29,000 acres toward historic reference conditions.

Relationship to Forest Goals and Objectives: Alternative B would meet goshawk forest plan canopy cover requirements in VSS 4 to 6 in all acres except the 29,017 acres managed for an open reference condition. In all acres but the open reference condition acres, actions would move toward forest plan desired VSS size class distribution.

The amendment is consistent with forest goals for wildlife and fish of managing habitat to maintain viable populations of wildlife and fish species and improve habitat for selected species (Coconino National Forest Plan, replacement page 22-1) and to improve habitat for listed threatened, endangered, or sensitive species of plants and animals and other species as they become threatened or endangered (Coconino National Forest Plan, replacement page 23).

Relationship to Management Prescriptions: Table 95 displays the acres associated with Coconino NF management areas (MAs).

Canopy Cover: The acres of forestwide MAs affected by the canopy cover portion of the amendment (139,308 acres total) would range from 3 percent (MA 4) to 35 percent (MA 38). The amendment is specific to this project and would not impose definition and clarification requirements on the future management of canopy cover within goshawk habitat.

Open Reference Condition: The acres of forestwide MAs affected by the open reference condition portion of the amendment (29,017 acres total) would range from 1 percent (MA 10) to 9 percent (MA 35). The amendment is consistent with the management emphasis of providing for multiple uses that includes wildlife habitat (MA 3) and moving ponderosa pine toward desired forest structure, including northern goshawk habitats (MA 35). The amendment is specific to this project and would not impose requirements on the future management of the 29,017 acres of goshawk non-PFA; however, forest plan revision decisions may change future management.

Table 95. Alternative B amendment 2 management area acres (Coconino NF)

MA	MA Description	Forestwide Acres	Proposed Amendment Acres	Forestwide Acres Affected (Percent)
Canopy Cover				
MA 3	Ponderosa pine below 40% slopes	511,015	92,301	18
MA 35	Lake Mary watershed	62,536	14,337	23
MA 38	West	36,298	12,844	35
MA 6	Unproductive Timber Lands	67,146	4,929	7
MA 37	Walnut Canyon	20,566	4,536	22
MA 20	Highway 180 corridor	7,608	2,087	27
MA 4	Ponderosa pine and mixed conifer >40%	46,382	1,612	3
MA 36	Schultz	21,289	1,815	9
*MA 9, 28, 5, 4, 10, 36, 34, 7, 12, 18, 15, and 14	See chapter 1, table 14	549,579	4,847	<1
Open Reference Condition				
MA 3	Ponderosa pine below 40% slopes	511,015	19,010	4
MA 35	Lake Mary watershed	62,536	5,840	9
MA 10	Transition grassland	160,494	1,288	1
MA 38	West	36,298	1,073	3
**MA 10, 9, 7, 12, 34, 28, and 5	See chapter 1, table 14	474,169	1,806	<1

*Acres of MAs range from 7 to 1,215 and were aggregated into one category.
**Acres of MAs range from 3 to 655 and were aggregated into one category.

Relationship to Outputs: Outputs identified in the current forest plan are associated with MMBF of sawtimber sales and products (meet demand for timber while reducing conflict with other resources), MMBF of firewood sold and free use (provide access to firewood), grazing capacity (MAUM), and permitted livestock use (MAUM).

The canopy cover portion of the amendment provides clarification and disclosure of methods for meeting forest plan requirements. It has no relationship to outputs or to the relationship between the level of goods (timber, firewood) and services and would not result in a change land productivity or timber suitability classification.

Managing a portion of the landscape for an open reference condition affects about 29,017 acres of an estimated 626,326 acres of suitable timber lands (USDA 1987). The management strategy on these acres would result in an extended rotation period between treatments beyond what was considered in developing the long-term sustained yield output in the forest plan. In the short term (10-year period), the amendment affects about 5 percent of the suitable land base. However, due to the minimal acres affected, the amendment would not measurably alter outputs in the foreseeable future on a forestwide basis or change the long-term relationship between levels of goods (timber, firewood) and services. There would be no change in land productivity; therefore, it would not affect timber suitability classification.

Whether the 29,017 acres would continue to be managed as suitable timber in the long term will be evaluated during the forest plan revision process. No portion of the amendment would affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use.

Amendment 3. Effect Determination for Cultural Resources (Coconino NF)

Amendment 3 is a specific, one-time variance for the Coconino NF restoration project. Once the project is complete, current forest plan direction would apply to the project area. The language proposed does not apply to any other forest project. The amendment would be authorized per direction in the National Forest Management Act of 1976 (NFMA) and its implementing regulations found in 36 CFR 219 (1982).

Amendment Description

The amendment deletes the standard that addresses achieving a “no effect” determination and adds the words “or no adverse effect” to the remaining standard. Management strives to achieve a “no effect” or “no adverse effect” determination.

Background

The Coconino NF forest plan as written has some conflicting direction regarding managing significant or potentially significant sites. One standard (which would be amended for this project) directs management to **strive** to achieve a “no effect” determination. A second standard (which would be deleted for this project) directs management to achieve a “no effect” determination in consultation with SHPO and ACHP (36 CFR 800). An amendment is proposed to recognize that there could be effects that are not adverse, and that there could be adverse effects that may or may not be fully mitigated. Table 96 displays current and proposed forest plan language. New or edited text is displayed in **bold** type.

Table 96. Alternative B amendment 3 effect determination for cultural resources (Coconino NF)

Current Coconino NF Forest Plan Direction	Proposed New Standards and Guidelines Language*
Cultural Resources	
Consult with Native Americans when projects and activities are planned in sites or areas of known religious or cultural importance (Coconino NF forest plan, page 52).	No Change
Make boughs and herbaceous plant parts used for Native American religious and ceremonial purposes available under conditions and procedures that minimize restrictions, consistent with laws, regulations, and agreements with tribes. The written authorization to the Hopi Tribe for gathering without specific individual permits is an example. This authorization does not include such items as firewood removed from the forest or Kiva logs, which do require a permit (Coconino NF forest plan, page 52).	No Change
The forest complies with the National Historic Preservation Act (NHPA) in decisions involving interactions between cultural and other resources. Cultural resources are managed in coordination with the State Historic Preservation Plan (SHPO). Until evaluated, the minimal level of management for all sites is avoidance and protection (Coconino NF forest plan, page 52).	No Change
Specific standards and guidelines derived from the settlement agreement for the Save the Jemez lawsuit are subject to adjustment, should that agreement be modified. In that event an amendment to the forest plan will be issued (Coconino NF forest plan, page 52).	No Change
Project undertakings are inventoried for cultural resources and areas of Native American religious use. Inventory intensity complies with regional policy, and the settlement agreement for the Save The Jemez Lawsuit, and is determined in consultation with the State Historic Preservation Officer (SHPO). Generally, inventory standards are: One hundred percent survey of all projects causing complete surface disturbance; when less than 100 percent survey is deemed appropriate, the specific sample fraction surveyed is determined in consultation with the State Historic Preservation Officer and is generally greater than 10 percent. Factors determining when sampling is appropriate include projects with dispersed or minimal impacts, low expected archaeological site density, ground cover, and types of archaeological sites present in the area; consultation with appropriate Native American groups; consultation with the SHPO, and if necessary, the Advisory Council on Historic Preservation (ACHP), before project implementation (Coconino NF forest plan, page 52-1).	No Change
Significant, or potentially significant, inventoried sites are managed to achieve a “No Effect” determination, in consultation with the SHPO and ACHP (36 CFR 800) (Coconino National Forest plan, page 53).	**Deleted**
Monitoring during and after project implementation is done to document site protection and condition (Coconino National Forest plan, page 53).	No Change
Management strives to achieve a “No Effect” determination (Coconino National Forest plan, page 53).	**Management strives to achieve a “no effect” or “no adverse effect” determination**
When sample surveys, rather than 100 percent survey coverage, are done for project clearances, survey locations and sample intensity are based on areas	No Change

Current Coconino NF Forest Plan Direction	Proposed New Standards and Guidelines Language*
of greatest project impact, likely locations for cultural resource sites based on archaeological experience, land management planning, dispersion of sample coverage, certain topographic features specified in the Save the Jemez lawsuit settlement agreement, and likely areas based on the forest site density predictions (Coconino National Forest plan, page 53).	
Identified sites are evaluated for their National Register eligibility when they are severely damaged, when they will be impacted by an undertaking, or information about the uniqueness, commonness, and characteristics of their site class are sufficiently known to make an informed decision. Sites for which determinations of eligibility have not been made are managed as if they are eligible, unless consultation with the SHPO indicates otherwise (Coconino National Forest plan, page 53).	No Change
For each full-time professional cultural resource specialist employed by the forest, at least two site nominations, one archaeological district nomination, or one thematic or multiple resource nomination will be made each year to the National Register of Historic Places. Or, alternatively, the forest will coordinate with other forests to prepare a joint district, thematic, or multiple resource nomination (Coconino National Forest plan, page 53).	No Change
Inventoried sites allocated to management categories, and/or eligible or potentially eligible for the NRHP or potentially eligible for the NRHP are systematically revisited by regularly scheduled patrols, and by cultural resources specialists to assess natural deterioration, vandalism, or pilfering. Inspections are made at least biannually of properties that have been listed in or nominated to the National Register. Sites most susceptible to natural deterioration and/or human disturbance are monitored frequently. Rapid natural deterioration, or susceptibility to such, requires stabilization, restoration, and/or data recovery. Vandalism or pilfering requires protective measures such as signing, remote sensing, increased patrolling, investigations, stabilization, restoration, and/or data recovery. Specific sites or areas may be closed to off-road driving and withdrawn from mineral entry. Law enforcement is planned and implemented to minimize resource damage and user conflicts. Signing is appropriate to inform and educate the public and minimize direct law enforcement activity. Aggressively pursue violations (Coconino National Forest plan, page 53).	No Change
Continue to interpret cultural resources through lectures, tours, papers, reports, publications, brochures, displays, films, trails, signs, and other opportunities (Coconino National Forest plan, page 54).	No Change
Develop a program to complete 100 percent coverage of the forest's cultural resource inventory by 2000 (Coconino National Forest plan, page 54).	No Change
The first priorities for cultural resources protection, enhancement, and interpretation are those sites that are easily accessible, have major interpretive potential, or are in major need of repair. Priority sites for signing are the C. Hart Merriam Base Camp, Honanki Cliff Dwellings, Elden Pueblo, Sacred Mountain, Palatki Cliff Dwellings, and Clear Creek Ruins. Priority sites for repair and stabilization are Honanki Cliff Dwellings, Palatki Cliff Dwellings, Sacred Mountain, Clear Creek Cliff Dwelling, and General Springs Cabin. Priority sites for developing interpretive brochures are Elden Pueblo, Sacred Mountain, Red Tank Draw Petroglyphs, Honanki Cliff Dwellings, Palatki Cliff Dwellings, and Clear Creek Ruins. Priorities are to:	No Change

Current Coconino NF Forest Plan Direction	Proposed New Standards and Guidelines Language*
Survey to clear projects. Survey to fill in gaps in existing inventory coverage. Survey areas of known high site densities. Survey areas that would do the most to answer current archaeological questions (Coconino National Forest plan, page 54).	
Computerize cultural resource site information by 1990 (Coconino National Forest plan, page 54).	No Change
Maintain a form for tracking compliance of each undertaking with the requirements of the National Historic Preservation Act (Coconino National Forest plan, page 54).	No Change
Stabilize or repair damaged National Register sites or other sites funded by regional priority (Coconino National Forest plan, page 54).	No Change
Continue to develop the Elden Pueblo Interpretive Site and the cooperative education program with the Museum of Northern Arizona (Coconino National Forest plan, page 54).	No Change
Encourage universities to conduct summer field schools to assist in cultural resource survey and excavation work and to provide the forest with scientific knowledge (Coconino National Forest plan, page 54).	No Change
Periodically focus media attention on Elden Pueblo and/or other sites to educate the public and further volunteer interest in resource management. Work with community organizations, businesses, and other agencies to promote Arizona Archaeology Week. Feature significant finds and significant damage in the media to increase public awareness of benefits and problems (Coconino National Forest plan, page 54).	No Change

* Edited and new/added text is **bolded.**

Significance Evaluation

Per FSM 1926.51, changes to the land management plan that are not significant can result from:

1. Actions that do not significantly alter the multiple-use goals and objectives for long term land and resource management.
2. Adjustments of management area boundaries or management prescriptions resulting from further onsite analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long term land and resource management.
3. Minor changes in standards and guidelines.
4. Opportunities for additional projects or activities that will contribute to achievement of the management prescription.

Per FSM 1926.52, circumstances that may cause a significant change to a land management plan include:

1. Changes that would significantly alter the long-term relationship between levels of multiple-use goods and services originally projected (see section 219.10(e) of the

planning regulations in effect before November 9, 2000 (see 36 CFR parts 200 to 299, revised as of July 1, 2000)), and

2. Changes that may have an important effect on the entire land management plan or affect land and resources throughout a large portion of the planning area during the planning period.

The proposed amendment is nonsignificant (FSM 1926.51) because multiple-use goals and objectives for long term land and resource management and its actions would not be altered. How the amendment could potentially affect timing, location and size, relationship to forest goals, objectives, outputs, and management prescriptions was evaluated:

Timing: In terms of timing, the forest plan has been in place (and amended) since 1987 and plan revision efforts are underway.

Location and Size: The amendment is specific to the 593,211 acres of proposed treatments in this project. This affects about 33 percent of the Coconino NF (which totals 1,821,495 acres). This would not have an important effect on the entire land management plan or a large portion of the planning area. For this reason, location and size was determined to be nonsignificant.

Relationship to Forest Goals and Objectives: The amendment would not affect attainment of forest goals and objectives for cultural resources. Cultural resource sites would be located and protected from project activities according to direction in FSM 2360 and 2430 (Coconino NF Forest Plan, page 50) and the requirements of 36 CFR 800 including 36 CFR 800.5, which provides direction for assessing adverse effects and proposing a finding of no adverse effect. Consultation with AZ SHPO would occur as required, and regulation 36 CFR 800 would be followed and met.

Relationship to Management Prescriptions: The amendment would apply to all 23 management areas (MA) as described in the Coconino National Forest plan (pages 46 to 206-113) and in chapter 1 of the DEIS. The amendment would not affect management of the MAs. All cultural resources are currently managed to minimize impacts and to achieve a “no effect” or “no adverse effect” determination whenever possible, in consultation with AZ SHPO, the council, and other consulting parties.

Relationship to Outputs: Outputs identified in the forest plan are associated with MMBF of sawtimber sales and products (meet demand for timber while reducing conflict with other resources), MMBF of firewood sold and free use (provide access to firewood), grazing capacity (MAUM), and permitted livestock use (MAUM).The amendment would not affect outputs or change the long-term relationship between levels of goods (timber, firewood) and services. All cultural resources are managed to minimize impacts and to achieve a “no effect” or “no adverse effect” determination whenever possible, in consultation with AZ SHPO, the council, and other consulting parties regardless of forest plan desired outputs.

Alternative B – Kaibab National Forest Site-Specific Nonsignificant Forest Plan Amendments

Two site-specific, nonsignificant forest plan amendments are proposed for alternative B.

Two Related Planning Efforts

A revised MSO recovery plan, issued by the U.S. Fish and Wildlife Service (hereafter referred to as FWS) was finalized in December of 2012 (USDI 2012). The current forest plan is consistent with the previous recovery plan (USDI 1995). At some point in time, the Kaibab NF may amend its forest plan to be consistent with the revised recovery plan. For this analysis, a forest plan amendment would be needed to utilize the revised recovery plan direction if it is different than what is currently included in the Kaibab NF land management plan.

Currently, the Kaibab NF is revising its forest plan. An analysis was conducted to determine how the proposed amendments align with the draft plan (as currently written) (USDA 2012). A revised forest plan may affect the need for amendments in the following ways:

Amendment 1: The current Kaibab NF forest plan has canopy cover requirements in VSS 4 to VSS 6, has requirements for managing goshawk habitat for a balance of VSS, and requirements for managing for three to five reserve trees in management created openings (greater than 1 acre in ponderosa pine in goshawk foraging areas and PFAs). Management direction for goshawk habitat is presented differently in the current draft forest plan (USDA 2012, page 14 to page 18). Amendment 1 would be in alignment with the draft forest plan (as currently written) as it: (1) provides for managing crowns of trees within the mid-aged to old groups as interlocking or nearly interlocking (USDA 2012 page 15); (2) manages forest conditions in some areas (e.g., goshawk PFAs, MSO protected areas, drainages, and steep north-facing slopes) with 10 to 20 percent higher basal area in mid-aged to old tree groups (USDA 2012, page 16); and(3) manages for known and replacement nest areas (USDA 2012, page 45).

The draft forest plans allow for project specific plan amendments. The portion of the amendment that allows deviation from maintaining three to five reserve trees for acres and having openings up to 90 percent for lands managed for an open reference condition would be consistent with what is allowed at the project level. The desired condition in ponderosa pine at the landscape scale is a ponderosa pine forest vegetation community with a mosaic of forest conditions composed of structural stages ranging from young to old trees. The forest is generally uneven-aged and open. Groups of old trees are mixed with groups of younger trees. Occasional areas of even-aged structure are present. Denser tree conditions exist in some locations such as north-facing slopes, canyons, and drainage bottoms (USDA 2012, page 16).

The amendment would still be required. The terms “interspaces,” “open reference condition,” and “stands” do not appear in the draft forest plan (as currently written). The amendment would need to continue providing this definition. The amendment would provide additional site-specific direction and definitions that apply to landscape restoration that are not precluded by the draft forest plan.

Amendment 2: The amendment would be in alignment with the draft forest plan (as currently written) in that it defers management of MSO to direction in the MSO recovery plan. The revised (2012) MSO recovery plan does not limit tree removal from within PACs to a specific d.b.h., nor does it require a specific method for habitat monitoring. Although restricted habitat is referred to as “recovery habitat” and “nest/roost habitats” in the 2012 revised plan (USDI 2012, pp. 3, 4), the project’s desired conditions for nesting and roosting habitat is consistent with the revised recovery plan. The revised plan still recommends that a percentage (10 to 25 percent) of recovery habitat be managed as nesting/roosting (USDI

2012, page VIII). Designating habitat in the project with the best potential would move toward desired percentages in recovery habitat. Amendment 2 would provide additional site-specific requirements at the project scale that would not be precluded by the revised forest plan or the revised recovery plan (USDI 2012).

Amendment 1. Management of Canopy Cover and Ponderosa Pine with an Open Reference Condition within Goshawk Habitat (Kaibab NF)

Amendment 1 is a specific, one-time variance for the Kaibab NF restoration project. Once the project is complete, current forest plan direction would apply to the project area. The language proposed does not apply to any other forest project. The amendments would be authorized per direction in the National Forest Management Act of 1976 (NFMA) and its implementing regulations found in 36 CFR 219 (1982).

Amendment Description

In the “Vegetation Management – Landscapes Outside Goshawk Post-fledgling Family Areas” and “Vegetation Management –Within Post-fledgling Family Areas” section of the forest plan, a nonsignificant plan amendment would: (1) add the desired percentage of interspace within uneven-aged stands to facilitate restoration, (2) add the interspace distance between tree groups, (3) add language clarifying where canopy cover is and is not measured, (4) allows 27,637 acres to be managed for an open reference condition (which affects canopy cover guidelines for VSS 4 through VSS 6 groups and reserve trees), and (5) add a definition to the forest plan glossary for the terms interspaces, open reference condition, and stands. Edited or added/new text is **bolded** in the “Proposed New Guideline Language” column in table 97. Figure 53 and figure 54 display general locations affected by canopy cover and savanna and grassland restoration treatments.

The Kaibab National Forest plan (hereafter referred as “forest plan”) directs projects to manage for uneven-aged stand conditions within goshawk habitat. Forested groups consist of an interspersion of six vegetation structural stages (VSS 1 to VSS 6). For the purposes of this amendment, the following definitions apply:

- **Stands** are defined as a contiguous area of trees sufficiently uniform in forest type, composition, structure, and age class distribution, growing on a site of sufficiently uniform conditions to be a distinguishable unit. Four classification characteristics are generally used to distinguish forest stands: biophysical site (soils, aspect, elevation, plant community association, climate, etc.), species composition, structure (density, and age (1-aged, 2-aged, uneven-aged)), and management emphasis (administrative requirements and local management emphasis that will shape structure over time). Based upon Agency guidelines, the minimum stand mapping size is 10 acres.
- **Interspaces** are defined as the open space between tree groups intended to be managed for grass/forb/shrub vegetation during the long term. Interspaces may include scattered single trees.
- **Open reference condition** is defined as forested ponderosa pine areas with mollic-integrade soils to be managed as a relatively open forest with trees typically aggregated in small groups within a grass/forb/shrub matrix.

Background

Canopy cover is defined as “the percentage of a fixed area covered by the crowns of plants delimited by a vertical projection of the outermost perimeter of the spread of foliage” (Reynolds et al. 1992). Obtaining consistent results has been difficult; even the definition of the term is dependent on the method of measurement. To resolve this issue, the Forest Service used the Forest Vegetation Simulation (FVS) crown width model as the basis for developing stocking densities that would achieve desired canopy cover levels.

The forest plan directs projects to measure “vertical crown projection on average across the landscape” (see Kaibab NF land management plan, page 29). Whereas the forest plan clearly provides direction for meeting minimum canopy cover percentages in VSS 4 to 6, the plans lack explicit language for measuring canopy cover. Although the forest plan provides direction and desired conditions for the vegetation structural stages, the forest plan does not describe the relationship between nonforested areas (interspace) and natural openings across the landscape.

Nonforested areas (interspaces) occur between individual trees, tree clumps, and tree groups. These nonforested areas (interspaces) are not equivalent to VSS 1. Whereas VSS 1 may provide openings in the short term, this structural stage is expected to regenerate tree cover in the long term. Refer to the silviculture report and the implementation plan (appendix D) which provides minimum stocking guidelines that have been developed to assure canopy cover requirements are met.

Approximately 198,136 acres (61 percent) of the forested areas (within the project area) have an open reference condition that corresponds to mollic-integrade soils. The desired condition is to have a portion of these acres (27, 637 acres) managed as a relatively open forest with trees typically aggregated in small groups within a grass/forb/shrub matrix (Woolsey 1911, Cooper 1960, White 1985, Pearson 1950, Covington et a1.1997, Abella and Denton 2009). See the soils specialist report for detailed information.

Table 97. Alternative B amendment 1 – management of canopy cover and ponderosa pine with an open reference condition in goshawk habitat (Kaibab NF)

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
Landscapes Outside Goshawk PFAs	
No corresponding forest plan direction (see Kaibab NF forest plan, p. 29).	**General: Within ponderosa pine stands, manage over time for uneven-aged stand conditions composed of heterogeneous mosaics of tree groups and single trees, with interspaces between tree groups. The size of tree groups, as well as sizes and shapes of interspaces, should be variable. Over time, the spatial location of the tree groups and interspaces may shift within the uneven-aged stand.**
General: The distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir forests is 10% grass/forb/shrub (VSS 1), 10% seedling-sapling (VSS 2), 20% young forest (VSS 3), 20% mid-aged forest (VSS 4), 20% mature forest (VSS 5), 20% old forest (VSS 6). NOTE: The specified percentages are a guide and actual percentages are expected to vary + or – up to 3% (Kaibab NF Forest Plan, p. 29).	General: **For the areas managed for tree crown development**, the distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir forests is 10 percent grass/forb/shrub (VSS 1), 10 percent seedling-sapling (VSS 2), 20 percent young forest (VSS 3), 20 percent mid-aged forest (VSS 4), 20 percent mature forest (VSS 5), and 20 percent old forest (VSS 6). Note: the specified percentages are a guide and actual percentages are expected to vary plus or minus up to 3 percent.
The distribution of VSS, tree density, and tree age are a product of site quality in the ecosystem management area. Use site quality to guide in the distribution of VSS, tree density and tree ages. Use site quality to identify and manage dispersal PFA and nest habitat at 2 to 2.5 mile spacing across the landscape (Kaibab NF forest plan, p.29).	No Change
Snags are 18" or larger d.b.h. and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape (Kaibab NF forest plan, p. 29).	Snags are 18" or larger d.b.h. and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, **canopy cover as defined by vertical crown projection is evaluated within mid-aged to old forest vegetation structural stage groups (VSS 4, 5, and 6).**
No corresponding forest plan direction	**Develop and maintain a highly diverse vegetation mosaic: 30 to 90 percent of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns. Within areas managed for an open reference condition, 10 to 30 percent of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns.**
No corresponding forest plan direction	**Tree group spatial distribution may be highly variable based on local site and current conditions; the interspaces between groups may range from 20 to 200 feet, but generally between 25 and 100 feet apart from drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.**

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
No corresponding forest plan direction	**Each tree group is generally dominated by one vegetation structure stage. The spatial arrangement of trees, high dispersion of vegetation structural stage diversity, and interspaces comprise each uneven-aged forest stand. Collectively these stands aggregate to uneven-aged forest landscapes, similar to natural conditions.**
The order of preferred treatment for woody debris is: (1) prescribed burning, (2) lopping and scattering, (3) hand piling or machine grapple piling, (4) dozer piling (Kaibab NF forest plan, p. 29).	No Change
Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stages (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stages (VSS 1, VSS 2, and VSS 3) (Kaibab NF forest plan, p. 29).	Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stage **groups** (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stage **groups** (VSS 1, VSS 2, and VSS 3) **or in interspaces, natural meadows, grasslands, or other areas not managed for forest cover.**
Spruce-Fir: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60% and 2/3 40%, mature forest (VSS 5) should average 60+%, and old forest (VSS 6) should average 60+%. Maximum opening size is 1 acre with a maximum width of 125 feet. Provide 2 groups of reserve trees per acre with 6 trees per group when opening size exceeds 0.5. Leave at least 3 snags, 5 downed logs, and 10–15 tons of woody debris per acre (Kaibab NF forest plan, p. 29).	No Change
Mixed Conifer: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 40+%, mature forest (VSS 5) should average 50+%, and old forest (VSS 6) should average 60+%. Maximum opening size is up to 4 acres with a maximum width of up to 200 feet. Retain 1 group of reserve trees per acre of 3–5 trees per group for openings greater than 1 acre in size. Leave at least 3 snags, 5 downed logs, and 10–15 tons of woody debris per acre (Kaibab NF forest plan, pp. 29–30).	No Change
Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5) should average 40+%, and old forest (VSS 6) should average 40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3–5 trees per group, will be left if the opening is greater than an acre in size. Leave at least 2 snags per acre, 3 downed logs per acre, and 5–7 tons of woody debris per acre (Kaibab NF forest plan, p.30).	Ponderosa Pine: Canopy cover for mid-aged forest (VSS 4) should average 40+ percent, mature forest (VSS 5) should average 40+ percent, and old forest (VSS 6) should average 40+ percent. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, three to five trees per group, will be left if the **created regeneration** opening is greater than an acre in size. Leave at least two snags per acre, three downed logs per acre, and 5 to 7 tons of woody debris per acre. **In acres managed for an open reference condition, canopy cover guidelines for VSS 4 through VSS 6 groups would not apply. One group of reserve trees, with a minimum of one to two trees per group will be left if the interspace size is greater than an acre in size.**

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
	Interspace size is up to 4 acres. Leave at least two snags per acre, three downed logs per acre, and 5 to7 tons of woody debris per acre.
Woodland: manage for uneven age conditions to sustain a mosaic of vegetation densities (overstory and understory), age classes, and species composition well distributed across the landscape. Provide for reserve trees, snags, and down woody debris (Kaibab NF forest plan, p. 30).	No Change
Vegetation Management – Within PFAs	
General: Provide for a healthy sustainable forest environment for the post-fledgling family needs of goshawks. The principle difference between within the post-fledgling family area and outside the post-fledgling family area is the higher canopy cover within the post-fledgling family area and smaller opening size within the post-fledgling family area. Vegetative structural stage distribution and structural conditions are the same within and outside the post-fledgling family area (Kaibab NF forest plan, p. 30).	No Change
No corresponding forest plan direction	**Canopy cover is evaluated at the group level within mid-aged to old forest structural stages groups (VSS 4, VSS 5, and VSS 6) and not within grass/forb/shrub to young forest structural stage groups (VSS 1, VSS 2, and VSS 3) or in interspaces, natural meadows and grasslands, or other areas not managed for forest conditions.**
Spruce-fir: Canopy Cover for mid-aged forest (VSS 4) should average 60+% and for mature (VSS 5) and old forest (VSS 6) should average 70+% (Kaibab NF forest plan, p. 30).	No Change
Mixed Conifer: Canopy Cover for mid-aged (VSS 4) to old forest (VSS 6) should average 60+% (Kaibab NF plan, p. 30).	No Change
Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 50+%. Mature (VSS 5) and old forest (VSS 6) should average 50+% (Kaibab NF forest plan, p. 30).	No Change
Woodland: Maintain existing canopy cover levels (Kaibab NF plan, p. 30)	No Change
No corresponding forest plan direction	**Develop and maintain a highly diverse vegetation mosaic: 30 to 90 percent of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns.**
No corresponding forest plan direction	**Tree group spatial distribution may be highly variable based on local site and current conditions; the interspaces between groups may range from 20 to 200 feet, but generally between 25 and 100 feet apart from**

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
	drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.
No corresponding forest plan direction	**Each tree group is generally dominated by one vegetation structure stage. The spatial arrangement of trees, high dispersion of VSS structural stage diversity, and interspaces comprise each uneven-aged forest stand. Collectively these stands aggregate to uneven-aged forest landscapes, similar to natural conditions.**
Glossary	
No corresponding forest plan direction	**Interspaces: The open space between tree groups intended to be managed for grass/forb/shrub vegetation during the long term. Interspaces may include scattered single trees.**
No corresponding forest plan direction	**Stands: Contiguous area of trees sufficiently uniform in forest type, composition, structure, and age class distribution, growing on a site of sufficiently uniform conditions to be a distinguishable unit.**
No corresponding forest plan direction	**Open reference condition: Forested ponderosa pine areas with mollic-integrade soils to be managed as a relatively open forest with trees typically aggregated in small groups within a grass/forb/shrub matrix.**

* Edited and new/added text is **bolded.**

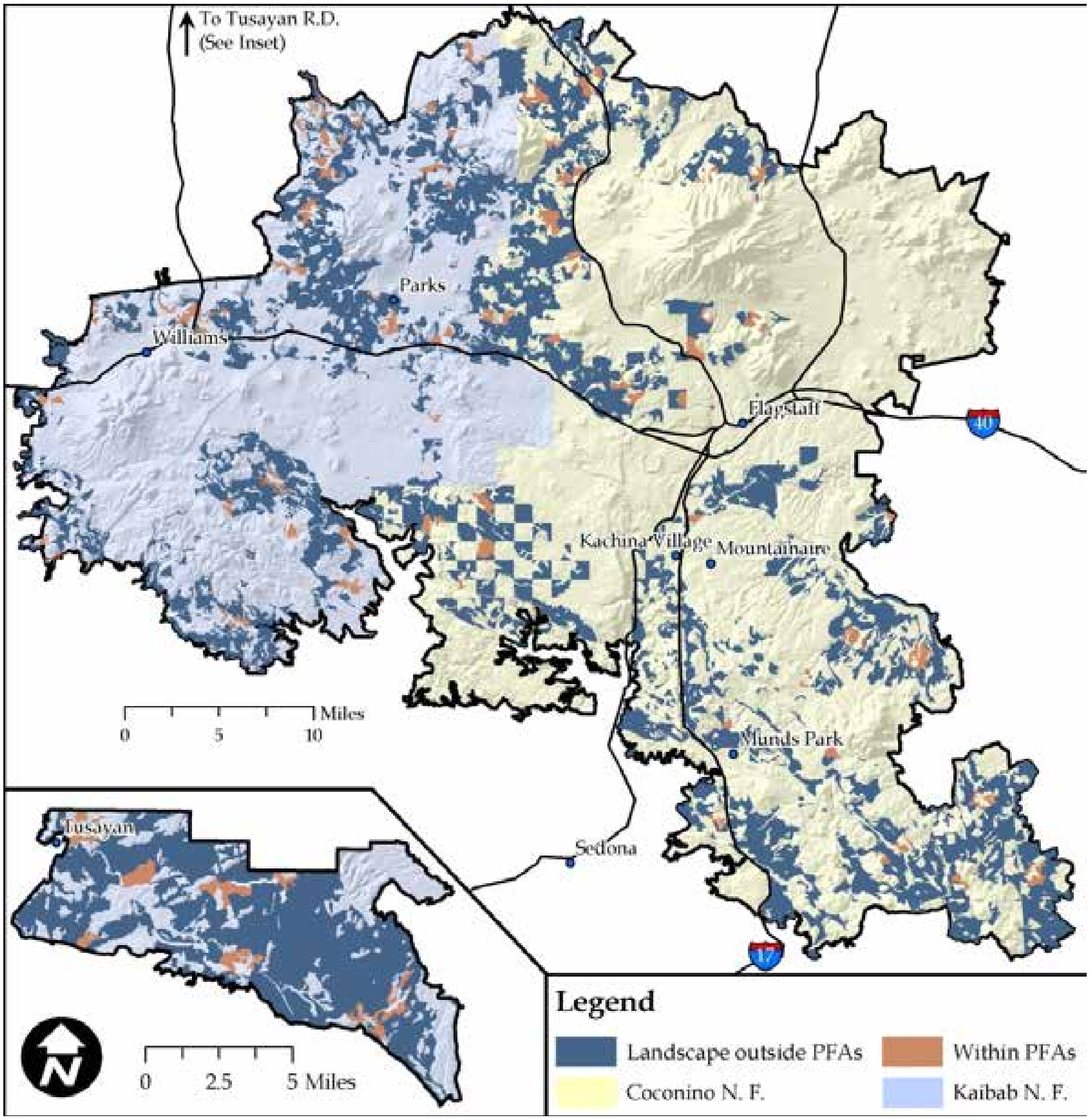

Figure 53. Alternative B general location of goshawk habitat subject to canopy cover requirements in VSS 4 to VSS 6 (Coconino NF and Kaibab NF)

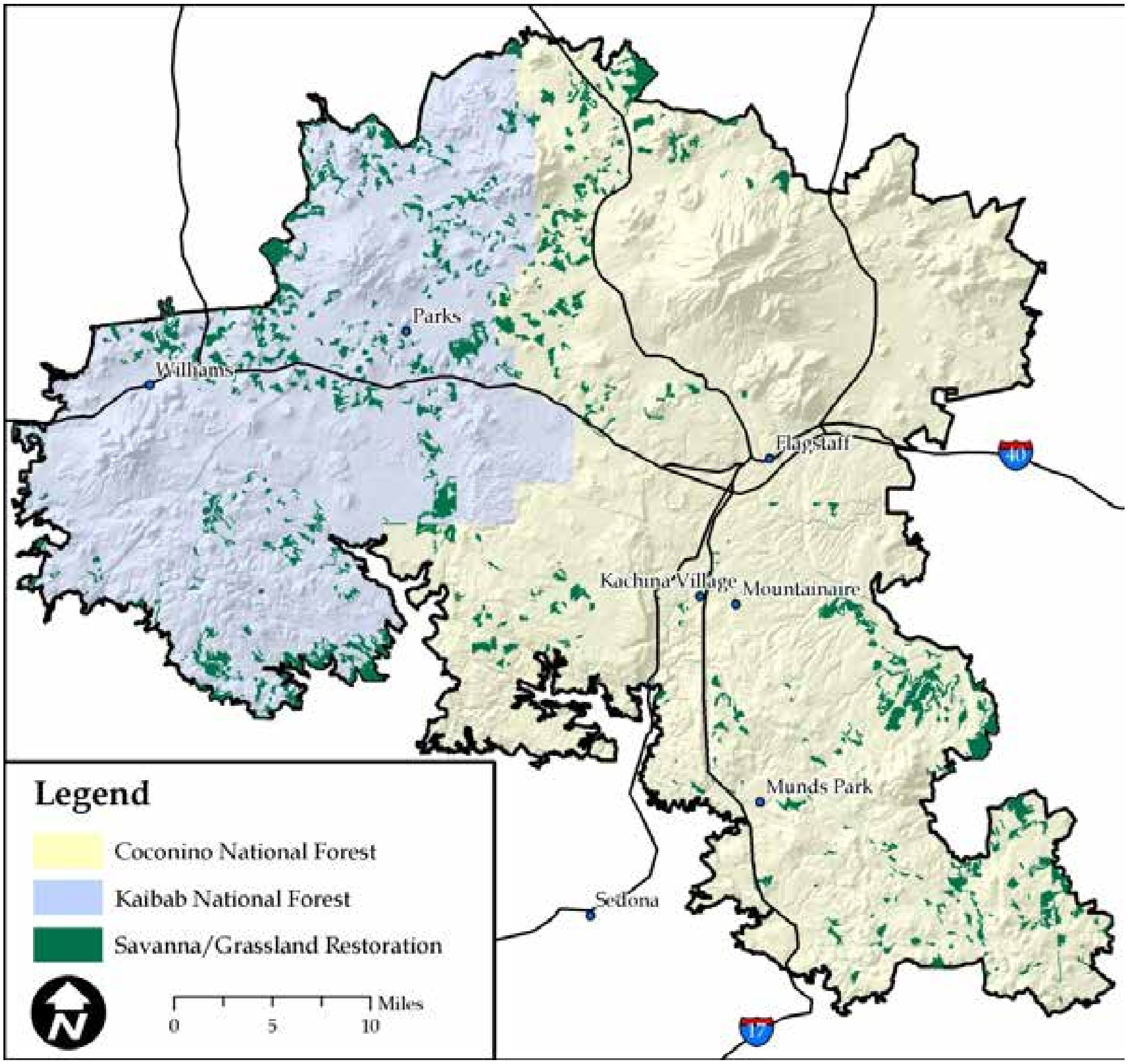

Figure 54. Alternative B general locations of savanna and grassland restoration treatments (Coconino NF and Kaibab NF)

Significance Evaluation

Per FSM 1926.51, changes to the land management plan that are not significant can result from:

1. Actions that do not significantly alter the multiple-use goals and objectives for long term land and resource management.
2. Adjustments of management area boundaries or management prescriptions resulting from further onsite analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long term land and resource management.
3. Minor changes in standards and guidelines.
4. Opportunities for additional projects or activities that will contribute to achievement of the management prescription.

Per FSM 1926.52, circumstances that may cause a significant change to a land management plan include:

1. Changes that would significantly alter the long-term relationship between levels of multiple-use goods and services originally projected (see section 219.10(e) of the planning regulations in effect before November 9, 2000 (see 36 CFR parts 200 to 299, revised as of July 1, 2000)), and
2. Changes that may have an important effect on the entire land management plan or affect land and resources throughout a large portion of the planning area during the planning period.

Analysis demonstrated that the proposed amendment is nonsignificant (FSM 1926.51) because the actions would not measurably alter the multiple-use goals and objectives for long term land and resource management and the actions. How actions could potentially affect timing, location and size, relationship to forest goals, objectives, outputs, and management prescriptions was evaluated.

Timing: The “Kaibab National Forest Land and Resources Management Plan” has been in place (and amended) since 1988 and plan revision efforts are underway. While the amendment does provide clarification that has been lacking since the forest plan was implemented, it is specific to this project.

Location and Size: Suitable goshawk habitat on the Kaibab NF encompasses approximately 541,000 acres (Keckler 2011, unpublished data) and the project area is comprised of about 399,633 acres of goshawk habitat. The amendment would affect approximately 20 percent of all suitable goshawk habitats on the forest and about 27 percent of goshawk habitat within the project area. For this reason, location and size was determined to be nonsignificant.

Relationship to Forest Goals and Objectives: Alternative B would meet goshawk forest plan canopy cover requirements in VSS 4 to 6 in all acres except the 27,637 acres managed for an open reference condition. In all acres but the open reference condition acres, actions would move toward the desired VSS size class distribution.

For this reason, the amendment is consistent with forest goals for wildlife and fish that promotes improving habitats through the development of habitat quality, diversity, and the identification and protection of key habitats. The amendment is consistent with the goal of improving habitats for listed threatened, endangered, or sensitive species of plants and animals and other species as they become threatened or endangered (Kaibab NF plan, page18).

Relationship to Management Prescriptions: Table 98 displays the acres associated with Kaibab NF geographic areas (GAs) and land use zones (LUZ).

> **Canopy Cover:** The acres of forestwide GAs and LUZ affected by the canopy cover portion of the amendment (106,585 acres total) would range from less than 1 percent (LUZ 21) to 33 percent (GA 10). The amendment is specific to this project and would not impose requirements on the future management of canopy cover within these acres of goshawk habitat.

> **Open Reference Condition**: The acres of forestwide GAs affected by the open reference condition portion of the amendment (27,637 acres total) would range from less than 1 percent

(GA 1) to 9 percent (GA 2).The amendment is consistent with the management emphasis of providing for multiple uses that includes wildlife habitat and moving ponderosa pine toward desired forest structure, including northern goshawk habitats. The amendment is specific to this project and would not impose requirements on the future management of the 27,637 acres of goshawk non-PFA; however, forest plan revision decisions may.

Table 98. Alternative B amendment 2 geographic area acres

GA	GA Description	Forestwide Acres	Proposed Amendment Acres	Forestwide Acres Affected (Percent)
Canopy Cover				
GA 2	Williams Forestland	308,394	73,352	24
GA 10	Tusayan Forestland	86,250	28,247	33
GA 3	North Williams Woodland	65,533	1,287	2
GA 1	Western Williams Woodland	169,041	1,970	1
GA 8	Tusayan Woodland	195,118	1,025	1
LUZ 21	Developed recreation sites	1,556	702	<1
Mapping Error	Camp Navajo	NA – Not in land management plan area	2	NA
Open Reference Condition				
GA 2	Williams Forestland	308,394	26,831	9
GA 3	North Williams Woodland	65,533	500	1
GA 1	Western Williams Woodland	169,041	302	<1
Mapping Error	Camp Navajo	NA – Not in land management plan area	4	NA

Relationship to Outputs: Outputs identified in the forest plan are associated with sawtimber and other product harvest levels (meet demand for timber while reducing conflict with other resources), commercial and personal use firewood programs (MBF), grazing capacity (AUM), watershed (acres in unsatisfactory condition and water yield), developed recreation (management of public sites at the standard service level), developed and dispersed recreation outputs (RVD), transportation (acres closed to off-road vehicle use), habitat diversity (change in habitat diversity index), old growth habitat (acres), and average annual wildlife and fish use (WFUD).

The canopy cover portion of the amendment provides clarification and disclosure of methods for meeting forest plan requirements. It has no relationship to outputs or to the relationship between the level of goods (timber, firewood) and services and would not result in a change to land productivity or timber suitability classification.

Managing a portion of the landscape for an open reference condition affects about 27,637 acres of an estimated 490,368 acres of suitable timber lands. The management strategy on these acres would result in an extended rotation period between treatments beyond what was considered in developing the long-term sustained yield output in the forest plan. In the short term (10-year period), the amendment affects about 6 percent of the suitable land base. Due to the minimal acres affected, the amendment would not measurably alter outputs in the foreseeable future on a forestwide basis or change the long-term relationship between levels of goods (timber, firewood) and services. There would be no change in land productivity; therefore, it would not affect timber suitability classification.

Whether the 27,637 acres would continue to be managed as suitable timber in the long term will be evaluated during the forest plan revision process. No portion of the amendment would affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use.

Amendment 2. MSO Habitat Management (Kaibab NF)

Amendment 2 is a specific, one-time variance for the Kaibab NF portion of the restoration project. Once the project is complete, current forest plan direction would apply to the project area. The language proposed does not apply to any other forest project. The amendment would be authorized per direction in the National Forest Management Act of 1976 (NFMA) and its implementing regulations found in 36 CFR 219 (1982).

Amendment Description

The amendment, which is specific to restricted habitat in pine-oak, would allow for designating less than 10 percent of restricted habitat on the Kaibab NF as target or threshold (i.e., future nesting and roosting habitat) based on the quality of the habitat. Definitions of target and threshold habitat would be added since the current forest plan refers to “threshold” in terms of values and desired conditions (see Kaibab NF forest plan, page 25) within restricted habitat and there is no reference to “target” conditions.

The amendment would remove language that limits PAC treatments in the recovery unit to 10 percent increments and language that requires the selection of an equal number of untreated PACs as controls. The amendment would remove language referencing monitoring (pre- and post-treatment, population, and habitat monitoring). Replacement language would defer final project design and monitoring to the FWS’ biological opinion specific to MSO for the project.

Background

MSO Monitoring

Monitoring assesses the effectiveness of management actions and provides the adaptive framework needed to develop successful management. Monitoring habitat facilitates modeling future forest conditions to determine if there will be adequate habitat to support MSO populations. For this project, the final design of the treatments and monitoring the results of the proposed activities in all MSO habitat would be developed in consultation with the FWS.

Manage Up to 10 Percent of Restricted Habitat as Target or Threshold

In 2011, biologists from the Coconino and Kaibab NFs, the 4FRI team, and the FWS worked together to develop a geographic layer for restricted habitat across the 4FRI treatment area. Data from the Kaibab and Coconino NFs (based on polygons) was merged with pine-oak data from the Lab of Landscape Ecology and Conservation Biology (raster data; Dr. Steve Sesnie and Jill Rundall, Northern Arizona University). This landscape-scale approach better meets the goal of providing continuous replacement nesting and roosting habitat over space and time, as described in the previous (1995) recovery plan and the 1996 “Record of Decision for the Amendment of Eleven Forest Plans.” A new restricted layer was created within the 4FRI treatment area, including designation of target and threshold habitat as described in the 1995 recovery plan.

The Kaibab NF consists of three disjunct ranger districts. The North Kaibab Ranger District is north of the Grand Canyon and in a different recovery unit. No resident MSOs have been identified on the North Kaibab and the district is outside the 4FRI planning boundary. The Tusayan and Williams districts are both south of the Grand Canyon and in the 4FRI planning boundary. The Tusayan district does not include spotted owl habitat, and there are no records of spotted owls occurring on the district. The Williams district has limited pine-oak habitat. In achieving a landscape-scale assessment for the 4FRI, MSO pine-oak habitat was assessed across the Williams district and much of the Coconino NF.

The MSO recovery plan describes past planning as operating at “limited spatial scale[s]” which precludes a more meaningful review of MSO habitat at ecological scales (USDI 1995). The scale of the 4FRI and the fact it transcends administrative boundaries allows managers to conduct a true landscape-scale analysis. Overall, about 11.5 percent (8,713 acres) of the 4FRI restricted habitat would be managed as current or future target or threshold habitat. On the Coconino NF portion of the project, where the most owls and the most MSO habitat occurs, 13 percent (6,465 acres) of the restricted layer would be designated as target or threshold habitat. The Kaibab NF portion of the 4FRI treatment area would have 8 percent (2,247 acres) of the restricted layer designated as target or threshold habitat. By creating more future nesting and roosting habitat on the Coconino NF, future MSO habitat would be more contiguous for dispersing MSOs, and occur in areas supporting higher densities of MSOs than if 10 percent of the restricted layer was designated by individual administrative boundaries.

Edited or added/new forest plan text is **bolded** in table 99.

Table 99. Alternative B amendment 2 MSO proposed forest plan standard and guideline language (Kaibab NF)

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
MSO Standards	
No corresponding direction currently exists	**The project will comply with the biological opinion that has been developed in consultation with FWS.**
Provide three levels of habitat management -protected, restricted, and other forest and woodland types to achieve a diversity of habitat conditions across the landscape (Kaibab NF forest plan, page 22).	No Change

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Protected areas include delineated protected activity centers; mixed conifer and pine-oak forests with slopes greater than 40% where timber harvest has not occurred in the last 20 years; and reserved lands which include wilderness, research natural areas, wild and scenic rivers, and congressionally recognized wilderness study areas (Kaibab NF forest plan, page 22).	No Change
Restricted areas include all mixed-conifer, pine-oak, and riparian forests outside of protected areas (Kaibab NF forest plan, page 22).	No Change
Other forest and woodland types include all ponderosa pine, spruce-fir, woodland, and aspen forests outside protected and restricted areas (Kaibab NF forest plan, page 22).	No Change
Survey all potential spotted owl areas including protected, restricted, and other forest and woodland types within an analysis area plus the area 1/2 mile beyond the perimeter of the proposed treatment area (Kaibab NF forest plan, page 23).	No Change
Establish a protected activity center at all Mexican spotted owl sites located during surveys and all management territories established since 1989 (Kaibab NF forest plan, page 23).	No Change
Allow no timber harvest except for firewood and fire risk abatement in established protected activity centers. For protected activity centers destroyed by fire, windstorm, or other natural disaster, salvage timber harvest or declassification may be allowed after evaluation on a case-by-case basis in consultation with U.S. Fish and Wildlife Service (Kaibab NF forest plan, page 23).	No Change
Allow no timber harvest except for fire risk abatement in mixed conifer and pine-oak forests on slopes greater than 40% where timber harvest has not occurred in the last 20 years (Kaibab NF forest plan, page 23).	No Change
Limit human activity in protected activity centers during the breeding season (Kaibab NF forest plan, page 23).	No Change
In protected and restricted areas, when activities conducted in conformance with these standards and guidelines may adversely affect other threatened, endangered, or sensitive species or may conflict with other established recovery plans or conservation agreements; consult with U.S. Fish and Wildlife Service to resolve the conflict (Kaibab NF forest plan, page 23).	No Change
Monitor changes in owl populations and habitat needed for de-listing (Kaibab NF forest plan, page 23).	**Deleted**
Guidelines – A. General – No Change	
Guidelines – B. Protected Areas, Protected Activity Centers	
Delineate an area of not less than 600 acres around the activity center using boundaries of known habitat polygons and/or topographic features. Written justification for boundary delineation should be	No Change

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
provided (Kaibab NF forest plan, page 23).	
The protected activity center boundary should enclose the best possible owl habitat configured in as compact a unit as possible, with the nest or activity center located near the center (Kaibab NF forest plan, page 23).	No Change
The activity center is defined as the nest site. In the absence of a known nest, the activity center should be defined as a roost grove commonly used during breeding. In the absence of a known nest or roost, the activity center should be defined as the best nest/roost habitat (Kaibab NF forest plan, page 23).	No Change
Protected activity center boundaries should not overlap (Kaibab NF forest plan, page 23).	No Change
Submit protected activity center maps and descriptions to the recovery unit working group for comment as soon as possible after completion of surveys (Kaibab NF forest plan, page 23).	No Change
Road or trail building in protected activity centers should be avoided but maybe permitted on a case-by-case basis for pressing management reasons (Kaibab NF forest plan, page 23).	No Change
Generally allow continuation of the level of recreation activities that was occurring prior to listing (Kaibab NF forest plan, page 23).	No Change
Require bird guides to apply for and obtain a special use permit. A condition of the permit shall be that they obtain a sub-permit under the U.S. Fish and Wildlife Service Master endangered species permit. The permit should stipulate the sites, dates, number of visits and maximum group size permissible (Kaibab NF forest plan, pages 23 to 24).	No Change
Harvest firewood when it can be done in such a way that effects on the owl are minimized. Manage within the following limitations to minimize effects on the owl (Kaibab NF forest plan, page 24).	No Change
Retain key forest species such as oak (Kaibab NF forest plan, page 24).	No Change
Retain key habitat components such as snags and large downed logs (Kaibab NF forest plan, page 24).	No Change
Harvest conifers less than 9 inches in diameter only within those protected activity centers treated to abate fire risk as described below (Kaibab NF forest plan, page 24).	No Change
Treat fuel accumulations to abate fire risk (Kaibab NF forest plan, page 24).	No Change

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Select for treatment 10% of the protected activity centers where nest sites are known in each recovery unit having high fire risk conditions. Also select another 10% of the protected activity centers where nest sites are known as a paired sample to serve as control areas (Kaibab NF forest plan, page 24).	**Deleted**
Designate a 100 acre “no treatment” area around the known nest site of each selected protected activity center. Habitat in the no treatment area should be as similar as possible in structure and composition as that found in the activity center (Kaibab NF forest plan, page 24).	No Change
Retain woody debris larger than 12 inches in diameter, snags, clumps of broad-leafed woody vegetation, and hardwood trees larger than 10 inches in diameter at the root collar (Kaibab NF forest plan, page 24).	No Change
Select and treat additional protected activity centers in 10% increments if monitoring of the initial sample shows there were no negative impacts or there were negative impacts which can be mitigated by modifying treatment methods (Kaibab NF forest plan, page 24).	**Deleted**
Treat fuel accumulations to abate fire risk: Use combinations of thinning trees less than 9 inches in diameter, mechanical fuel treatment, and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100-acre “no treatment” area (Kaibab NF forest plan, p. 24).	No Change
Treat fuel accumulations to abate fire risk. Select for treatment 10% of the protected activity centers where nest sites are known in each recovery unit having high fire risk conditions. Also select another 10% of the protected activity centers where nest sites are known as a paired sample to serve as control areas (Kaibab NF forest plan, page 24).	Treat fuel accumulations to abate fire risk.
Use light prescribed fire in non-selected protected activity centers on a case-by-case basis. Burning should avoid a 100-acre “no treatment” area around the activity center. Large woody debris, snags, clumps of broad-leafed woody vegetation should be retained and hardwood trees larger than 10 inches diameter at the root collar (Kaibab NF forest plan, page 24).	No Change
Pre- and post-treatment monitoring should be conducted in all protected activity centers treated for fire risk abatement (see monitoring guidelines). (Kaibab NF forest plan, page 24).	**Deleted**

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Steep Slopes (Mixed conifer and pine-oak forests outside protected activity centers with slopes greater than 40% that have not been logged within the past 20 years)	
No seasonal restrictions apply. Treat fuel accumulations to abate fire risk (Kaibab NF forest plan, page 24).	No Change
Use combinations of thinning trees less than 9 inches in diameter, mechanical fuel removal, and prescribed fire (Kaibab NF forest plan, page 24).	No Change
Retain woody debris larger than 12 inches in diameter, snags, clumps of broad-leafed woody vegetation, and hardwood tress larger than 10 inches in diameter at the root collar (Kaibab NF forest plan, page 24).	No Change
Pre and post treatment monitoring should occur within all steep slopes treated for fire risk abatement. (See monitoring guidelines) (Kaibab NF forest plan, page 24).	**Deleted**
Reserved Lands (Wilderness, Research Natural Areas, Wild and Scenic Rivers, and Congressionally Recognized Wilderness Study Areas	
Allow fire use where appropriate.	No Change
C. Restricted Areas (Mixed Conifer, Pine-Oak, and Riparian Forests)	
Mixed Conifer and Pine-oak Forests (See glossary definition)	
No corresponding direction	**Target habitat is a category of restricted habitat intended to provide future nesting and roosting habitat (see glossary definition for restricted habitat). The minimum values identified for the forest attributes represent the threshold for meeting nesting and roosting conditions (see the definition for threshold habitat). They can also be targets to be achieved with time and management. If less than 10 percent of the restricted habitat in ponderosa pine-Gambel oak qualifies as threshold habitat, the areas that can eventually achieve all threshold conditions simultaneously should be identified as target habitat and managed to achieve threshold conditions as rapidly as possible. Because no known nests or roosts occur in restricted habitat, target habitat is considered future nesting and roosting habitat.**
No corresponding direction	**Threshold habitat is a category of restricted habitat intended to provide for future nesting and roosting habitat (see definition for restricted habitat). A variety of forest structural attributes are used to define when nesting and roosting habitat is achieved (summarized in table III.B.1 of**

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
	the 1995 recovery plan and table C-2 of the 2012 recovery plan). Threshold habitat meets or exceeds these values. When the minimum values identified for the forest attributes are met simultaneously, they represent the threshold of nesting and roosting conditions. Up to 10 percent of restricted habitat in ponderosa pine-Gambel oak should be designated as threshold habitat. Management in threshold habitat cannot lower any of the forest attribute values below the nesting and roosting threshold unless a landscape analysis demonstrates an abundance of this habitat. Because no known nests or roosts occur in restricted habitat, target habitat is managed as future nesting and roosting habitat.
Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species (Kaibab NF forest plan, page 25).	No Change
The following table displays the minimum percentage of restricted area which should be managed to have nest/roost characteristics. The minimum mixed conifer restricted area includes 10% at 170 basal area and an additional 15% of area at 150 basal area. The variables are for stand averages, are minimum threshold values and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum threshold values should be reduced below the threshold values unless a districtwide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting the threshold values. Management should be designed to create minimum threshold conditions on project areas where there is a deficit of stands simultaneously meeting minimum threshold conditions unless the districtwide or larger landscape analysis shows there is a surplus (Kaibab NF forest plan, page 25).	**Table 13** displays the minimum percentage of restricted area which should be managed to have nest/roost characteristics. The minimum mixed conifer restricted area includes 10 percent at 170 basal area and an additional 15 percent of area at 150 basal area. **In pine-oak, the restricted area includes up to 10 percent at 170 BA and 15 percent of area at 150 basal area.** The variables are for stand averages, are minimum threshold values and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum threshold values should be reduced below the threshold values unless a districtwide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting the threshold values. Management should be designed to create minimum **target and** threshold **habitat** conditions on project areas where there is a deficit of stands simultaneously meeting minimum threshold **habitat** conditions unless the districtwide or larger landscape analysis shows there is a surplus.

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*

Minimum Percentage of Restricted Areas Managed for Nest/Roost Characteristics

Variable	Mixed Conifer All RU	Mixed Conifer Other RU*	Pine-Oak Target and Threshold Habitat**
Restricted Area Percent	10%	+15%	**Up to** 10%
Stand Averages for:			
Basal Area	170	150	150
18 inch+ trees/ac	20	20	20
Oak Basal Area	NA	NA	20
Percent total existing:			
12–18 inches	10	10	15
18–24 inches	10	10	15
24+ inches	10	10	15

*Mixed Conifer Other RU applies to the Kaibab NF.

**Pine-Oak Target and Threshold Habitat applies to the Williams RD, Kaibab NF.

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Attempt to mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes, into management prescriptions (Kaibab NF forest plan, page 25).	No Change
Maintain all species of native trees in the landscape including early seral species (Kaibab NF forest plan, page 25).	No Change
Allow natural canopy gap processes to occur, thus producing horizontal variation in stand structure (Kaibab NF forest plan, page 25).	No Change
Extend rotation ages for even-aged stands to greater than 200 years. Silvicultural prescriptions should explicitly state when vegetative manipulation will cease until rotation age is reached (Kaibab NF forest plan, page 25).	No Change
Save all trees greater than 24 inches d.b.h. In pine-oak forests, retain existing large oaks and promote growth of additional large oaks (Kaibab NF forest plan, page 25).	No Change
Encourage prescribed and wildland fire use to reduce hazardous fuel accumulation. Thinning from below may be desirable or necessary before burning to reduce ladder fuels and the risk of crown fire (Kaibab NF forest plan, page 25).	No Change
Retain substantive amounts of key habitat components: Snags 18 inches in diameter and larger down logs over 12 inches midpoint diameter hardwoods for retention, recruitment, and replacement of large hardwoods (Kaibab NF forest plan, page 25).	No Change

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Riparian Areas – No Change	
Domestic Livestock Grazing – No Change	
Old Growth – No Change	
D. Other Forest and Woodland Types – No Change	
E. Specific Recovery Units on the Kaibab NF – No Change	
F. Monitoring Guidelines	
Monitoring and evaluation should be collaboratively planned and coordinated with involvement from each national forest, USFWS Ecological Services Field Office, USFWS Regional Office, USFS Regional Office, Rocky Mountain Research Station, recovery team, and recovery unit working groups (Kaibab NF forest plan, page 26).	**See “Standards” for monitoring direction**
Population monitoring should be a collaborative effort with participation of all appropriate resource agencies (Kaibab NF forest plan, page 26).	**Deleted**
Habitat monitoring of gross habitat changes should be a collaborative effort of all appropriate resource agencies (Kaibab NF forest plan, page 26).	**Deleted**
Habitat monitoring of treatment effects (pre- and post-treatment) should be done by the agency conducting the treatment (Kaibab NF forest plan, page 27).	**Deleted**
Rangewide: Track gross changes in acres of owl habitat resulting from natural and human caused disturbances. Acreage changes in vegetation composition, structure, and density should be tracked, evaluated, and reported. Remote sensing techniques should provide an adequate level of accuracy (Kaibab NF forest plan, page 27).	**Deleted**
In protected and restricted areas where silvicultural or fire abatement treatments are planned, monitor treated stands pre- and post-treatment to determine changes and trajectories in fuel levels; snag basal areas; live tree basal areas; volume of down logs over 12 inches in diameter; and basal area of hardwood trees over 10 inches in diameter at the root crown (Kaibab NF forest plan, page 27).	**Deleted**
Upper Gila Mountain, Basin and Range East, and Basin and Range West Recovery Units: Assist the recovery team and recovery unit working groups to establish sampling units consisting of 19 to 39 square mile quadrats randomly allocated to habitat strata. Quadrats should be defined based on ecological boundaries such as ridge lines and watersheds. Quadrat boundaries should not traverse owl territories (Kaibab NF forest plan, page 27).	**Deleted**

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Twenty percent of the quadrats will be replaced each year at random. Using the sample quadrats, monitor the number of territorial individuals and pairs per quadrat; reproduction; apparent survival; recruitment; and age structure. Track population density both per quadrat and habitat stratum (Kaibab NF Land Management Plan, page 27).	**Deleted**

* Edited and new/added text is **bolded.**

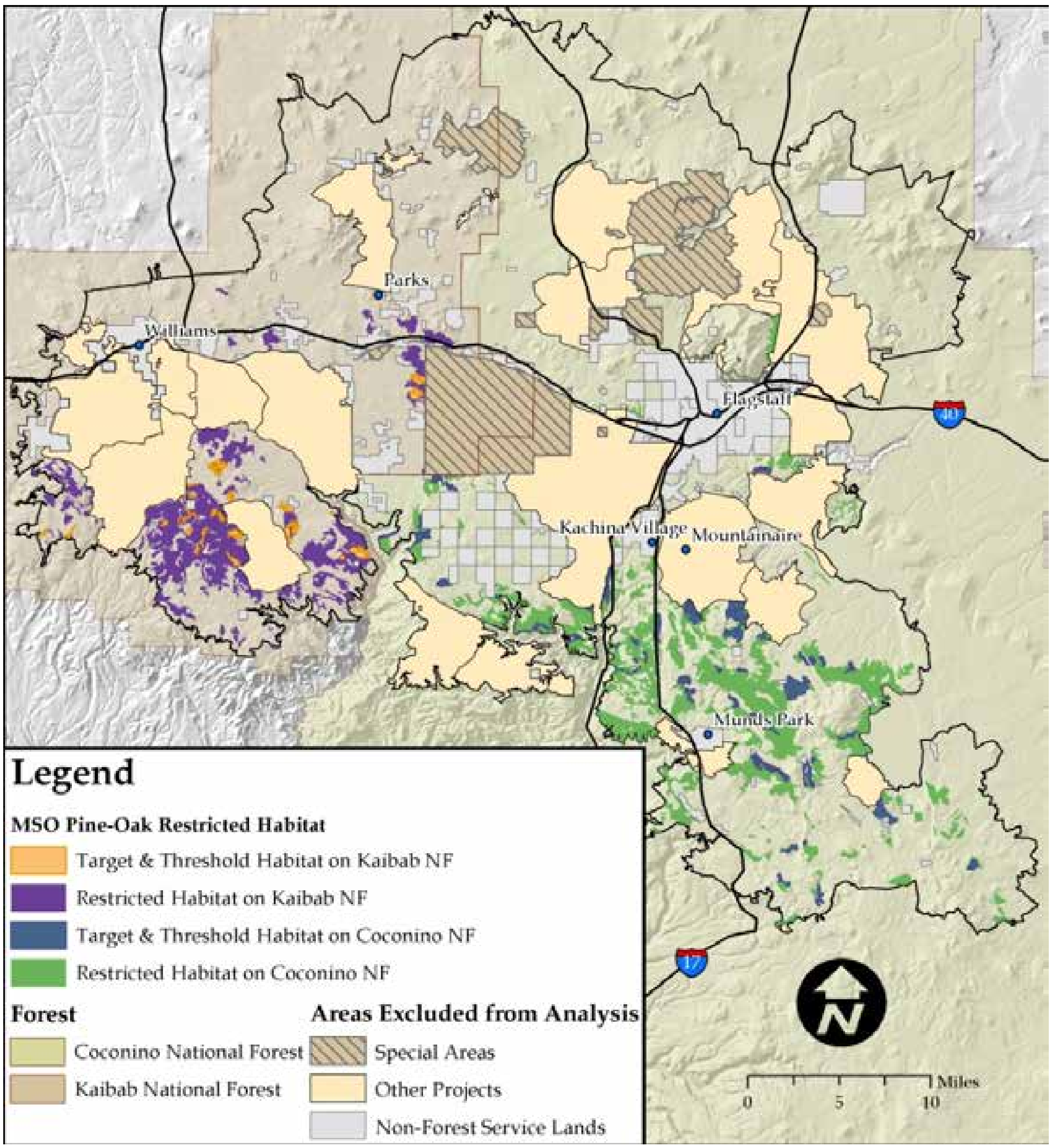

Figure 55. Alternative B amendment 2 landscape target and threshold analysis

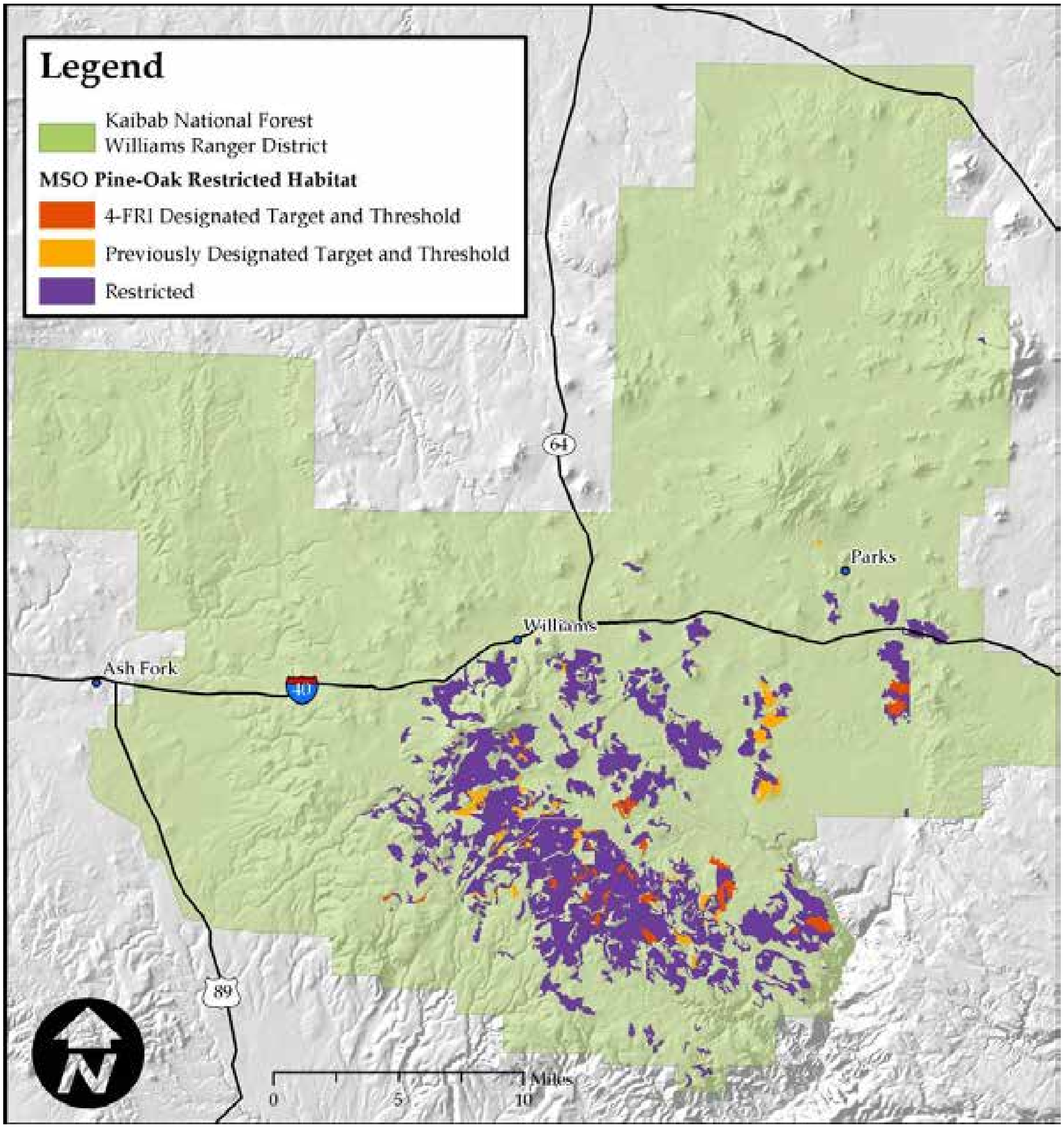

Figure 56. Alternative B–D MSO target and threshold habitat on the Kaibab NF

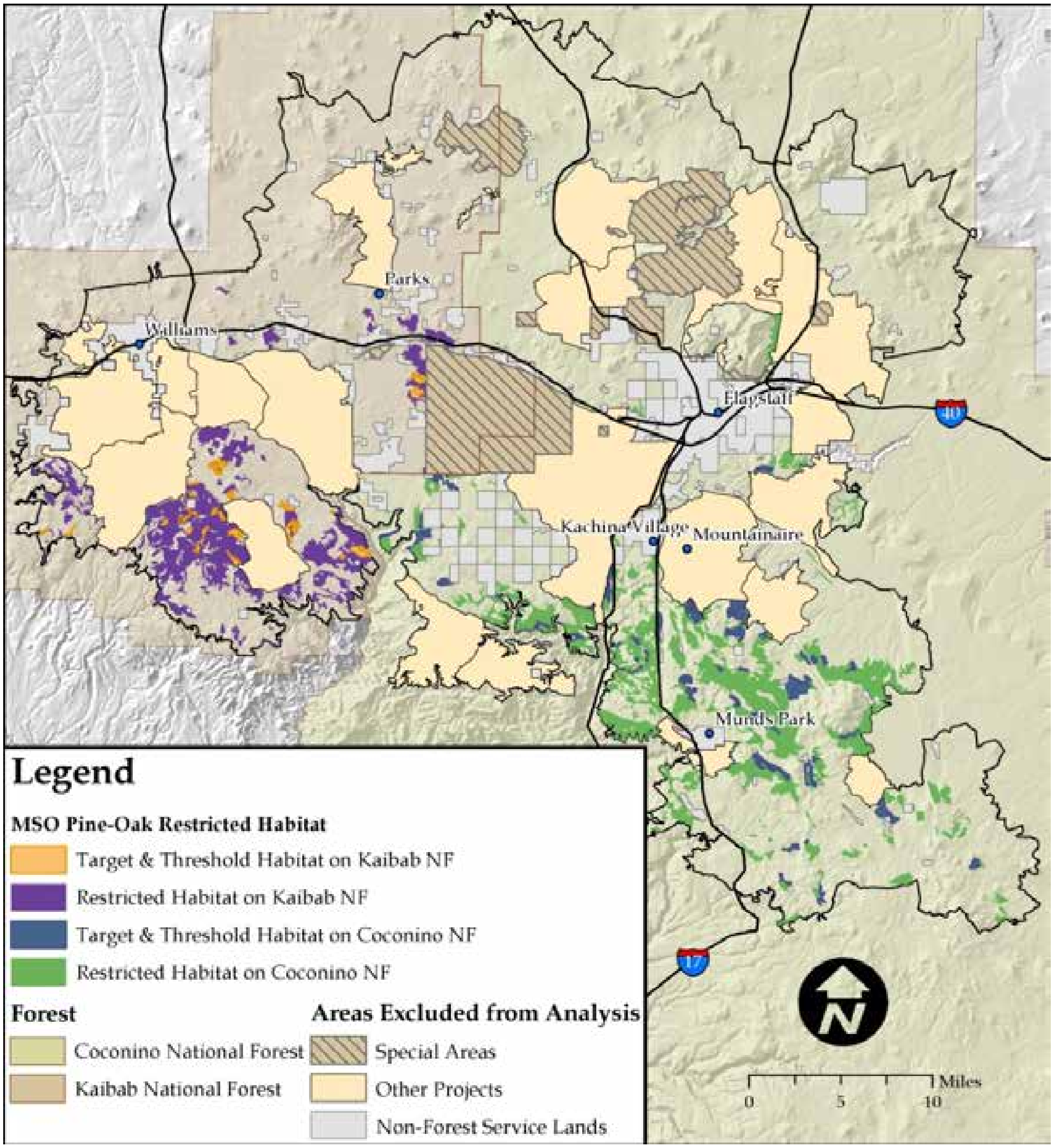

Figure 57. Project-scale designated MSO target and threshold habitat

Consistency with the MSO Recovery Plan

This amendment would allow for managing less than 10 percent of the designated restricted habitat as nest and roost habitat. MSO habitat is generally more abundant, more contiguous, and of higher quality on the Coconino NF than the Kaibab NF. This conclusion is based on forest data queries, years of on-the-ground experience of participants in the development of the restricted layer, and on presumed choices made by the owls themselves. MSOs are abundant and concentrated in pine-oak habitat on the Coconino NF. In contrast, there is only a single MSO detection dating from 1994 in pine-oak habitat on the Kaibab NF.

The recovery plan describes past planning as operating at “limited spatial scale[s]” which precludes a more meaningful review of MSO habitat at ecological scales (USDI 1995). The scale of the 4FRI and the fact it transcends administrative boundaries allows managers to conduct a true landscape-scale analysis. Overall, about 11.5 percent (8,713 acres) of the 4FRI restricted habitat would be managed as current or future target or threshold habitat. On the Coconino NF portion of the project, where the most owls and the most MSO habitat occurs, 13 percent (6,465 acres) of the restricted layer would be designated as target or threshold habitat.

The Kaibab NF portion of the 4FRI treatment area would have 8 percent (2,247 acres) of the restricted layer designated as target or threshold habitat. By creating more future nesting and roosting habitat on the Coconino NF, future MSO habitat would be more contiguous, better connected for dispersing MSOs, and occur in areas supporting higher densities of MSOs than if 10 percent of the restricted layer was designated by individual administrative boundaries.

This amendment meets the intent of the 1995 and revised (2012) recovery plan by reducing the potential for creating excessively fragmented habitat and managing stands based on their capability to attain desired stand conditions. This amendment does affect habitat designated in previous projects or in mixed-conifer habitat.

Adding a definition of target and threshold (restricted) habitat would be consistent with the desired conditions in the recovery plan (1995 and 2012 version). Although restricted habitat is referred to as “recovery habitat” and nest/roost habitat in the 2012 revised plan (USDI 2012, pp. 3, 4), the project’s desired conditions for nesting and roosting habitat is consistent with the revised recovery plan. The revised plan still recommends that a percentage (10 to 25 percent) of recovery habitat be managed as nesting/roosting (USDI 2012, page VIII). Using habitat with the best potential, the project would move toward desired percentages in recovery habitat. Amendment 2 would provide additional site-specific requirements at the project scale that would not be precluded by the revised forest plan or the new recovery plan (USDI 2012). Specific treatments have been designed to move toward improving the quality and quantity of target and threshold habitat that occurs within restricted habitat.

Deferring monitoring and incremental treatments to the FWS biological opinion would be consistent with the revised recovery plan (2012). The new recovery plan defers monitoring requirements to the management agency and treatment in incremental amounts is not recommended in the plan.

Significance Evaluation

Timing: In terms of timing, the forest plan has been in place and amended several times since 1988, and revision efforts are underway. The forest plan incorporated direction (via an amendment) from the Forest Service Southwestern Region’s 1996 “Amendment of Forest Plans Record of Decision” (USDA 1996). The actions allowed via the amendment are consistent with existing forest plan direction in that it improves nesting and rooting habitat, reduces the risk of loss from fire, and will comply with the site-specific treatment and monitoring requirements in the FWS biological opinion. Forest plan direction may be amended to incorporate the revised MSO recovery plan (USDI 2012) which recognizes that habitat restoration, in addition to the reduction of fire risk, is key to improving habitat quality.

Location and Size: There are 26,818 acres of MSO restricted habitat occurring entirely on the Kaibab NF. The amendment would affect the percentage of restricted acres designated as threshold habitat (8 percent), resulting in 2,247 acres on the Kaibab NF. About 11.5 percent of the designated restricted habitat would be managed for future nesting/roosting habitat across the 4FRI treatment area. Monitoring in all MSO habitat would be in compliance with the FWS biological opinion for the project.

Relationship to Forest Goals and Objectives: The amendment is consistent with forest plan goals for wildlife and fish of managing habitat to improve habitat quality and diversity in both the short and long term, to improve diversity and provide quality old-growth habitats (Kaibab National Forest plan, page 12), and to improve habitat for listed threatened, endangered, or sensitive species of plants and animals and work toward recovery and delisting of species (Kaibab National Forest plan, page 18).

Changing the minimal target/threshold acres in restricted habitat (2,247 acres) would not change the overall direction to manage for future nesting/roosting habitat on 10 percent of restricted acres across the planning area landscape as described in the forest plan. About 8,713 acres (about 11½ percent) are classified as target and threshold habitat in the 4FRI treatment area on both the Kaibab and Coconino National Forests.

The amendment removes language that addresses pre- and post-treatment, population and habitat monitoring and replaces it with language that focuses on implementing the requirements in the FWS biological opinion. Delaying treatment in and adjacent to the Kendrick PAC would leave occupied MSO habitat at risk of loss from high-severity fire. Arizona’s two largest fires account for nearly a million and half acres of forested land burned since 2002. Both fires included high-severity fire in PAC habitat. Other fires burning in the Upper Gila Recovery Unit have charred additional acres of MSO protected habitat. Most climate models suggest that the Southwest will experience higher temperatures and increased variability in precipitation, which will significantly affect fire regimes and forest health (Aumack et al. 2007).

The FWS urges a deliberate and cautious approach to management activities within PACs (USDI 2012). Silvicultural modeling of the proposed treatments indicates limited change to forest structure after implementation. However, the treatments are expected to include increased tree growth rates to reduce the time needed to for developing large trees (defined as 18-inch d.b.h. and greater in the current recovery plan for the MSO), maintaining existing large trees, and decreasing surface fuels and increasing crown base height. Combined, this is should develop and maintain MSO nesting and roosting habitat, a key aspect of the recovery plans, while decreasing risk of crown fire.

Forest restoration and fuels reduction treatments would be evaluated over time. Monitoring would be designed and implemented to evaluate the effects of prescribed fire and hazardous fuel reduction treatments on spotted owl habitat, and to retain or move toward MSO desired future conditions as described in the recovery plan. The details on accomplishing the monitoring goals will be developed specifically for this approach through coordination with the FWS under formal consultation, as described in the ESA. In this way, work to protect and improve owl habitat can be accomplished in a timely manner while emphasizing monitoring and feedback loops to allow management to be adaptive. For these reasons, the amendment as it relates to pre- and post-treatment, population and habitat monitoring is consistent with forest plan goals and objectives.

Designating target or threshold habitat in the project with the best potential would move toward desired percentages in restricted (recovery) habitat, consistent with forest plan goals and objectives.

Relationship to Management Prescriptions: The intent of managing 2,247 acres of restricted habitat to current or future threshold conditions is consistent with the management emphasis of providing for multiple uses that includes wildlife habitat and meeting MSO standards and guidelines which emphasize improving and maintaining the quality of the habitat and moving ponderosa pine toward desired forest structure, including MSO habitats (table 100). The amendment would affect about 8 percent of all MSO restricted habitat on the Kaibab NF and less than 1 percent of GA 2.

Table 100. Alternative B Kaibab NF amendment 2 GA acres

GA	GA Description	Forestwide Acres	Proposed Amendment Acres	Forestwide Acres Affected (Percent)
Restricted Habitat				
GA-2	Williams Forestland	308,394	2,247	< 0.01

Relationship to Outputs: In comparison to the forest's total suitable timber lands (479,132 acres), the amendment would affect less than 0.01 percent of those lands. For this reason, mechanical treatment within current MSO threshold or future threshold (i.e., target) habitat would not measurably increase or decrease timber outputs or firewood availability. There would be no measurable effect to outputs managing from deferring the final design of treatments and monitoring to the project's biological opinion. The amendment would not affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use.

Alternative C – Coconino National Forest Site-Specific Nonsignificant Forest Plan Amendments

Three site-specific, nonsignificant forest plan amendments are proposed for alternative C.

Related Planning Efforts

A revised MSO recovery plan, issued by the U.S. Fish and Wildlife Service (hereafter referred to as FWS) was finalized in December of 2012 (USDI 2012). The current forest plan is consistent with the previous recovery plan (USDI 1995). At some point in time, the Coconino NF may amend its forest plan to be consistent with the revised recovery plan. For this analysis, a forest plan amendment would be needed to utilize the revised recovery plan direction if it is different than what is currently included in the Coconino NF forest plan.

Currently, the Coconino NF is revising its forest plan. An analysis was conducted to determine how the proposed amendments align with the draft plan (as currently written) (USDA 2011). A revised forest plan may affect the need for amendments 1 through 3 in the following ways:

> **Amendment 1** would be in alignment with the draft forest plan (as currently written) in that it defers management of MSOs to direction in the MSO recovery plan. The revised (2012) MSO recovery plan does not limit tree removal from within PACs to a specific d.b.h., does

not require a specific method for habitat monitoring, the proposed basal area in nest/roost habitat is referenced in the 2012 revised plan, and the plan allows for the use of prescribed fire within PAC core areas outside the breeding season.

In the recovery plan, project monitoring is deferred to the management agency. For this project, monitoring would be determined in consultation with the FWS. Amendment 1 could be retained as it would provide additional site-specific direction for implementation at the project scale that would not be precluded by the forest plan or recovery plans.

Although restricted habitat is referred to as “recovery habitat” and “nest/roost habitats” in the 2012 revised plan (USDI 2012, pp. 3, 4), the project’s desired conditions for nesting and roosting habitat is consistent with the revised recovery plan. The revised plan still recommends that a percentage (10 to 25 percent) of recovery habitat be managed as nesting/roosting (USDI 2012, page VIII). Designating habitat in the project with the best potential would move toward desired percentages in recovery habitat. Amendment 1 would provide additional site-specific requirements at the project scale that would not be precluded by the revised forest plan or the revised recovery plan (USDI 2012).

Amendment 2: Canopy cover requirements in VSS 4 to VSS 6 and managing goshawk habitat for a balance of VSS is presented differently in the current draft forest plan (USDA 2011, pages 51 to 54). Amendment 2 would be in alignment with the draft forest plan (as currently written) as it: (1) provides for managing crowns of trees within the mid-aged to old groups as interlocking or nearly interlocking (USDA 2011 page 53); (2) manages forest conditions in goshawk PFAs with 10 to 20 percent higher basal area in mid-aged to old tree groups than in goshawk foraging areas and general forest (USDA 2011, Page 51); (3) manages for goshawk nest areas (known and replacement) (USDA 2011, page 53); and (4) generally maintains three to five reserve trees in management created openings greater than 1 acre in ponderosa pine in goshawk foraging areas and PFAs (USDA 2011 page 54), with the exception of acres managed for an open reference condition.

The draft forest plan (as currently written) allow for project specific plan amendments. The portion of the amendment that allows deviation from maintaining three to five reserve trees and having openings up to 90 percent for lands managed for an open reference condition would be consistent with what is allowed at the project level. At the landscape scale, the project would be consistent with the draft desired conditions for ponderosa pine which states, “Forest appearance is variable but generally uneven-aged and open; occasional areas of even-aged structure are present. The forest arrangement is in individual trees, small clumps, and groups of trees interspersed within variably sized openings of grass/forb/shrub vegetation associations similar to historic patterns. Size, shape, number of trees per group, and number of groups per area are variable across the landscape” (USDA 2011, page 51). The terms “interspaces” and “open reference condition” do not appear in the draft forest plans (as written). The amendment would need to continue providing this definition. The definition of “stand” could be removed from the amendment (USDA 2011, page 225). The amendment would provide additional site-specific direction and definitions that apply to landscape restoration that are not precluded by the draft forest plan.

Amendment 3 would not be required. As currently written, the draft forest plan desired condition is to generally manage for no adverse effects and minimize adverse impacts or impacts through consultation (USDA 2012).

Amendment 1. MSO Habitat Management (Coconino NF)

Amendment 1 is a specific, one-time variance for managing MSO habitat on the Coconino NF in the 4FRI restoration project. Once the project is complete, current forest plan direction would apply to the project area. The language proposed does not apply to any other forest project. The amendments would be authorized per direction in the National Forest Management Act of 1976 (NFMA) and its implementing regulations found in 36 CFR 219 (1982).

Amendment Description

Amendment 1 would allow mechanical treatments up to 18-inch d.b.h. to improve habitat structure (nesting and roosting habitat) in 18 MSO PACs. It would allow low intensity prescribed fire within 56 MSO PAC core areas. The amendment would remove language that limits PAC treatments in the recovery unit to 10 percent increments and language that requires the selection of an equal number of untreated PACs as controls. The amendment would remove language referencing monitoring (pre- and post-treatment, population, and habitat). Replacement language would defer final project design and monitoring to the FWS' biological opinion specific to MSO for the project.

The amendment, which is specific to restricted habitat in pine-oak, would allow for designating less than 10 percent of restricted habitat on the Coconino NF as target or threshold (i.e., future nesting and roosting habitat) based on the quality of the habitat. Definitions of target and threshold habitat would be added since the current forest plan refers to "threshold" in terms of values and desired conditions (see Coconino NF forest plan, page 65-3.) within restricted habitat, and there is no reference to "target" conditions. In restricted pine-oak habitat, it would allow 6,321 acres of restricted target or threshold habitat to be managed for a minimum range of 110 to 150 basal area.

Background

In 2011, biologists from the Coconino and Kaibab NFs, the 4FRI team, and the FWS worked together to review individual MSO PACs within the project area. The evaluation process includes site visits and modeling silvicultural treatments and prescribed fire to move existing owl habitat toward the desired conditions described in the 1995 MSO recovery plan (USDI 1995) and forest plan.

There are 99 PACs within the 4FRI project area and 72 PACs within the treatment area. Of the 72 PACs, 18 were identified as having habitat that could be improved with vegetation treatments. No PACs proposed for treatment are located in designated wilderness. Each stand within the 18 PACs was modeled to identify treatments that would yield the best existing and future MSO habitat conditions. See the wildlife specialist report "Methodology" section for complete details on the habitat evaluation process.

Mechanical Treatment Up to 18-inch d.b.h. in Select PACs (7,353 acres)

MSO PAC field reviews, data evaluation, and vegetation simulation modeling indicated 18 MSO PACs (approximately 3,388 acres or 10 percent of all PACs acres within the treatment area) would move toward recovery plan desired conditions from mechanically cutting trees up to 9-inch d.b.h. Treatments up to 9-inch d.b.h. are consistent with the forest plan. See the wildlife specialist report "Methodology" section for complete details on the habitat evaluation process.

An additional 7,353 acres within 18 PACs would have nesting and roosting habitat benefits from cutting trees up to 18-inch d.b.h. Mechanical treatments above 9-inch d.b.h. would facilitate the removal of ladder and canopy fuels which would reduce the fire risk in the 18 PACs. Increasing the range of the mechanical treatment thresholds up to 18-inch d.b.h. within 18 MSO PACs would provide for a higher degree of stand structure improvements to nesting and roosting habitat. The proposal addresses comments from the FWS and is in alignment with the revised MSO recovery plan (USDI 2012). Figure 58 displays the general location of mechanical treatment up to 18-inch d.b.h., prescribed fire, and areas where no treatment is proposed within MSO PACs.

Prescribed Fire Within 56 PAC Core Areas (About 5,600 acres)

In order to improve habitat conditions outside of the 100-acre core area within 56 PACs, there is a need to use prescribed fire within select PAC core areas. Without the use of low-intensity prescribed fire within the core, each core area would need to have fire line constructed around it to prevent fire from entering the nest site during treatment in the surrounding PAC habitat. Depending on site and weather conditions, this could be anything from a 3-foot-wide hand line to a dozer line. The number of acres potentially affected from fire line activities within PACs would likely range from 0.80 (hand line) acre to 3.2 (dozer) acres. Most fire line would require post-treatment habitat rehabilitation.

Burning in MSO PACs is difficult as there is a need to address the high fuel loadings while maintaining many of the habitat elements that contribute to fuel loading. Burning has to be conducted in a very short timeframe to avoid the breeding season (i.e., the nonbreeding season – September 1 to February 28). Lining 56 core areas greater than or equal to 100 acres would be expensive in terms of time, money, and other resource commitments. In many projects, PAC treatments have been eliminated for these reasons. Applying low intensity prescribed burning within the 100-acre core areas would eliminate the need for fire line construction and would potentially minimize impacts on at least 179 acres of protected habitat. Figure 59 displays the general location of MSO PACs proposed for prescribed burning including where burning would occur within core areas.

Manage Up to 10 Percent of Restricted Habitat as Target or Threshold

In 2011, biologists from the Coconino and Kaibab NFs, the 4FRI team, and the FWS worked together to develop a geographic layer for restricted habitat across the 4FRI treatment area. Data from the Kaibab and Coconino NFs (based on polygons) was merged with pine-oak data from the Lab of Landscape Ecology and Conservation Biology (raster data; Dr. Steve Sesnie and Jill Rundall, Northern Arizona University). This landscape-scale approach better meets the goal of providing continuous replacement nesting and roosting habitat over space and time, as described in the previous (1995) recovery plan and the 1996 “Record of Decision for the Amendment of Eleven Forest Plans.” A new restricted layer was created within the 4FRI treatment area, including designation of target and threshold habitat as described in the recovery plan.

The Kaibab NF consists of three disjunct ranger districts. The North Kaibab Ranger District is north of the Grand Canyon and in a different recovery unit. No resident MSOs have been identified on the North Kaibab and the district is outside the 4FRI planning boundary. The Tusayan and Williams districts are both south of the Grand Canyon and in the 4FRI planning boundary. The Tusayan district does not include spotted owl habitat and there are no records of spotted owls occurring on the district. The Williams district has limited pine-oak habitat. In achieving a landscape-scale assessment for the 4FRI, MSO pine-oak habitat was assessed across the Williams district and much of the Coconino NF.

The MSO recovery plan describes past planning as operating at “limited spatial scale[s]” which precludes a more meaningful review of MSO habitat at ecological scales (USDI 1995). The scale of the 4FRI and the fact it transcends administrative boundaries allows managers to conduct a true landscape-scale analysis. Overall, about 11.5 percent (8,713 acres) of the 4FRI restricted habitat would be managed as current or future target or threshold habitat. On the Coconino NF portion of the project, where the most owls and the most MSO habitat occurs, 13 percent (6,465 acres) of the restricted layer would be designated as target or threshold habitat. The Kaibab NF portion of the 4FRI treatment area would have 8 percent (2,247 acres) of the restricted layer designated as target or threshold habitat. By creating more future nesting and roosting habitat on the Coconino NF, future MSO habitat would be more contiguous for dispersing MSOs, and occur in areas supporting higher densities of MSOs than if 10 percent of the restricted layer was designated by individual administrative boundaries (see figure 60 and figure 62).

Manage 6,321 Acres of MSO Restricted Target and Threshold Habitat for a Minimum of 110 to 150 Basal Area

The development of 6,321 acres of restricted target and threshold habitats would be managed toward meeting a 110 to 150 basal area for MSO nest and roost habitat as recommended in the revised MSO recovery plan (USDI 2012). It would allow more of the uncharacteristic in-growth of mid-aged and mid-sized trees that currently dominate the 4FRI landscape to be removed while retaining nesting and roosting habitat components. Thinning more of these trees would improve forest health, increasing the ability to retain large trees and increase large tree growth rates as described in the revised recovery plan (USDI 2012). This would increase forest spatial heterogeneity, improve tree age diversity, and benefit prey habitat. Increasing the basal area range would provide opportunities to mimic canopy gap processes which produce horizontal variation in stand structure. These changes would both increase and retain nesting and roosting structure and increase understory cover. Research suggests that small mammal biomass (including voles and mice) drives spotted owl reproductive output, and thinning smaller trees would improve subcanopy flight zone, thereby increasing MSO foraging effectiveness. Figure 60 displays the extent of the landscape analysis conducted to designate MSO restricted habitat for the project. Figure 61 displays the project’s designated MSO restricted habitat.

Monitoring Responses to MSO Treatments

Monitoring assesses the effectiveness of management actions and provides the adaptive framework needed to develop successful management. Monitoring habitat facilitates modeling future forest conditions to determine if there will be adequate habitat to support MSO populations. For this project, the final design of the treatments and monitoring the results of the proposed activities in all MSO habitat would be developed in consultation with the FWS. Edited or added/new text is **bolded** in table 101.

Table 101. Alternative C amendment 1 MSO current and proposed forest plan language (Coconino NF)

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
MSO Standards	
No corresponding direction currently exists	**The project will comply with the biological opinion that has been developed in consultation with the FWS.**
Provide three levels of habitat management - protected, restricted, and other forest and woodland types to achieve a diversity of habitat conditions across the landscape (Coconino NF forest plan, p. 65)**.**	No Change
Protected areas include delineated protected activity centers; mixed conifer and pine-oak forests with slopes greater than 40% where timber harvest has not occurred in the last 20 years; and reserved lands which include wilderness, research natural areas, wild and scenic rivers, and congressionally recognized wilderness study areas (Coconino NF forest plan, p. 65)**.**	No Change
Restricted areas include all mixed-conifer, pine-oak, and riparian forests outside of protected areas (Coconino NF forest plan, p. 65).	No Change
Other forest and woodland types include all ponderosa pine, spruce-fir, woodland, and aspen forests outside protected and restricted areas (Coconino NF forest plan, p. 65).	No Change
Survey all potential spotted owl areas including protected, restricted, and other forest and woodland types within an analysis area plus the area 1/2 mile beyond the perimeter of the proposed treatment area (Coconino NF forest plan, p. 65).	No Change
Establish a protected activity center at all Mexican spotted owl sites located during surveys and all management territories established since 1989 (Coconino NF forest plan, p. 65).	No Change
Allow no timber harvest except for firewood and fire risk abatement in established protected activity centers. For protected activity centers destroyed by fire, windstorm, or other natural disaster, salvage timber harvest or declassification may be allowed after evaluation on a case-by-case basis in consultation with US Fish and Wildlife Service (Coconino NF forest plan, p. 65).	Allow no timber harvest except for firewood and fire risk abatement in established protected activity centers **except as follows: Allow firewood, fire risk abatement, and habitat structure improvement in the following established protected activity centers: Lake No. 1/Seruchos, Archies, Red Hill, Crawdad, Holdup, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Rock Top, Lee Butte, Foxhole, Bar M, and Sawmill Spring.** For protected activity centers destroyed by fire, windstorm, or other natural disaster, salvage timber harvest or declassification may be allowed after evaluation on a case-by-case basis in consultation with the U.S. Fish and Wildlife Service.

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Allow no timber harvest except for fire risk abatement in mixed conifer and pine-oak forests on slopes greater than 40% where timber harvest has not occurred in the last 20 years (Coconino NF forest plan, p. 65).	No Change
Limit human activity in protected activity centers during the breeding season (Coconino NF forest plan, p. 65).	No Change
In protected and restricted areas, when activities conducted in conformance with these standards and guidelines may adversely affect other threatened, endangered, or sensitive species or may conflict with other established recovery plans or conservation agreements; consult with U.S. Fish and Wildlife Service to resolve the conflict (Coconino NF forest plan, p. 65-1).	No Change
Monitor changes in owl populations and habitat needed for delisting (Coconino NF forest plan, page 65-1).	**See "Standards" for monitoring direction**
Guidelines – General – No Change	
Guidelines – Protected Areas, Protected Activity Centers	
Delineate an area of not less than 600 acres around the activity center using boundaries of known habitat polygons and/or topographic features. Written justification for boundary delineation should be provided (Coconino NF forest plan, page 65-1).	No Change
The protected activity center boundary should enclose the best possible owl habitat configured in as compact a unit as possible, with the nest or activity center located near the center (Coconino NF forest plan, page 65-1).	No Change
The activity center is defined as the nest site. In the absence of a known nest, the activity center should be defined as a roost grove commonly used during breeding. In the absence of a known nest or roost, the activity center should be defined as the best nest/roost habitat (Coconino NF forest plan, p. 65-1).	No Change
Protected activity center boundaries should not overlap (Coconino NF forest plan, p. 65-1).	No Change
Submit protected activity center maps and descriptions to the recovery unit working group for comment as soon as possible after completion of surveys (Coconino NF forest plan, p. 65-1).	No Change

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Road or trail building in protected activity centers should be avoided but maybe permitted on a case-by-case basis for pressing management reasons (Coconino NF forest plan, p. 65-1).	No Change
Generally allow continuation of the level of recreation activities that was occurring prior to listing (Coconino NF forest plan, p. 65-1).	No Change
Require bird guides to apply for and obtain a special use permit. A condition of the permit shall be that they obtain a subpermit under the U.S. Fish and Wildlife Service Master Endangered Species permit. The permit should stipulate the sites, dates, number of visits, and maximum group size permissible (Coconino NF forest plan, p. 65-1).	No Change
Harvest firewood when it can be done in such a way that effects on the owl are minimized. Manage within the following limitations to minimize effects on the owl (Coconino NF forest plan, p. 65-2). Retain key forest species such as oak. Retain key habitat components such as snags and large downed logs. Harvest conifers less than 9 inches in diameter only within those protected activity centers treated to abate fire risk as described below, **except for the Clark PAC where trees less than 16 inches diameter will be harvested**.	Harvest firewood when it can be done in such a way that effects on the owl are minimized. Manage within the following limitations to minimize effects on the owl. Retain key forest species such as oak. Retain key habitat components such as snags and large downed logs. Harvest conifers less than 9 inches in diameter only within those protected activity centers treated to abate fire risk as described below, except for the Clark PAC where trees less than 16 inches diameter will be harvested area except as follows: **Harvest conifers up to 18-inch diameter within the Lake No. 1/Seruchos, Archies, Red Hill, Crawdad, Holdup, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Rock Top, Lee Butte, Foxhole, Bar M, and Sawmill Spring PACs to abate fire risk and improve habitat structure.**
Treat fuel accumulations to abate fire risk. –Select for treatment 10% of the protected activity centers where nest sites are known in each recovery unit having high fire risk conditions. Also select another 10% of the protected activity centers where nest sites are known as a paired sample to serve as control areas (Coconino NF forest plan, page 65-2). –Designate a 100-acre "no treatment" area around the known nest site of each selected protected activity center. Habitat in the no treatment area should be as similar as possible in structure and composition as that found in the activity center. –Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark PAC), mechanical fuel treatment and prescribed fire to abate fire risk in the remainder of	Treat fuel accumulations to abate fire risk. –Designate a 100-acre "no treatment" area around the known nest site of each selected protected activity center. Habitat in the no treatment area should be as similar as possible in structure and composition as that found in the activity center. – Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark PAC), mechanical treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100-acre "no treatment" area **except as follows:** **Use combinations of thinning trees up to 18-inch d.b.h. within the Lake No. 1/Seruchos, Archies, Red Hill, Holdup, Rock Top, Foxhole, Bar M, PACs, Crawdad, Bonita Tank, Red Raspberry, Bear Seep, Mayflower Tank, Knob, T6 Tank, Iris Tank, Frank, Lee Butte, and**

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
the selected protected activity center outside the 100-acre "no treatment" area. Treat fuel accumulations to abate fire risk. Pre and post treatment monitoring should be conducted in all protected activity centers treated for fire risk abatement. (See monitoring guidelines) (Coconino NF forest plan, page 65-2)	**Sawmill Springs PACs**, mechanical fuel treatment and prescribed fire to abate fire risk **and improve habitat structure in the remainder of the selected protected activity center outside the 100-acre "no treatment" area. Use low intensity prescribed fire within 56 select 100-acre core areas to eliminate the need for fire line construction.** **–** Retain woody debris larger than 12 inches in diameter, snags, clumps of broad-leafed woody vegetation, and hardwood trees larger than 10 inches in diameter at the root collar. –Use light prescribed burns in nonselected protected activity centers on a case-by-case basis. Burning should avoid a 100-acre "no treatment" area around the activity center except as follows: **Use low intensity prescribed fire within 56 select 100-acre core areas to eliminate the need for fire line construction.** Large woody debris, snags, clumps of broad-leafed woody vegetation should be retained and hardwood trees larger than 10 inches diameter at the root collar. **–See "Standards" for Monitoring Direction**
Steep Slopes (Mixed conifer and pine-oak forests outside protected activity centers with slopes greater than 40% that have not been logged within the past 20 years): No seasonal restrictions apply.	
Treat fuel accumulations to abate fire risk. –Use combinations of thinning trees less than 9 inches in diameter, mechanical fuel removal, and prescribed fire. –Retain woody debris larger than 12 inches in diameter, snags, clumps of broadleafed woody vegetation, and hardwood trees larger than 10 inches in diameter at the root collar. – Pre and post treatment monitoring should occur within all steep slopes treated for fire risk abatement. (See monitoring guidelines)	Treat fuel accumulations to abate fire risk. –Use combinations of thinning trees less than 9 inches in diameter, mechanical fuel removal, and prescribed fire. –Retain woody debris larger than 12 inches in diameter, snags, clumps of broadleafed woody vegetation, and hardwood trees larger than 10 inches in diameter at the root collar. **–See "Standards" for Monitoring Direction**
Reserved Lands (Wilderness, Research Natural Areas, Wild and Scenic Rivers, and Congressionally Recognized Wilderness Study Areas): Allow prescribed fire where appropriate – No Change	
Restricted Areas (Mixed conifer, pine-oak, and riparian forests)	
No corresponding direction	**Target habitat is a category of restricted habitat intended to provide future nesting and roosting habitat (see glossary definition for restricted habitat). The minimum values identified for the forest attributes represent the threshold for meeting nesting and roosting conditions (see the definition for threshold habitat). They can also be targets to be achieved with time and management. If less than 10 percent of the restricted habitat in ponderosa pine-Gambel oak**

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
	qualifies as threshold habitat, the areas that can eventually achieve all threshold conditions simultaneously should be identified as target habitat and managed to achieve threshold conditions as rapidly as possible. Because no known nests or roosts occur in restricted habitat, target habitat is considered future nesting and roosting habitat.
No corresponding direction	**Threshold habitat is a category of restricted habitat intended to provide for future nesting and roosting habitat (see definition for restricted habitat). A variety of forest structural attributes are used to define when nesting and roosting habitat is achieved (summarized in table III.B.1 of the 1995 recovery plan and table C-2 of the 2012 recovery plan). Threshold habitat meets or exceeds these values. When the minimum values identified for the forest attributes are met simultaneously, they represent the threshold of nesting and roosting conditions. Up to 10 percent of restricted habitat in ponderosa pine-Gambel oak should be designated as threshold habitat. Management in threshold habitat cannot lower any of the forest attribute values below the nesting and roosting threshold unless a landscape analysis demonstrates an abundance of this habitat. Because no known nests or roosts occur in restricted habitat, target habitat is managed as future nesting and roosting habitat.**
Mixed Conifer and Pine-oak Forests (See glossary definition): Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species. The following table displays the minimum percentage of restricted area which should be managed to have nest/roost characteristics. The minimum mixed conifer restricted area includes 10% at 170 basal area and an additional amount of area at 150 basal area. The additional area of 150 basal area is +10% in BR-E and +15% in all other recovery units. The variables are for stand averages and are minimum threshold values and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum threshold values should be reduced below the threshold values unless a district-wide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting the threshold values. Management should be designed to create minimum threshold conditions on project areas where there is a deficit of stands simultaneously meeting minimum threshold conditions unless the district-wide or	Mixed Conifer and Pine-oak Forests (See glossary definition): Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species. The following table displays the minimum percentage of restricted area which should be managed to have nest/roost characteristics. The minimum mixed conifer restricted area includes up to 10 percent at 170 basal area and an additional amount of area at 150 basal area. The additional area of 150 basal area is +10 percent in BR-E and +15 percent in all other recovery units. **In pine-oak, the minimum restricted area includes up to 10 percent at 110 to 150 basal area.** The variables are for stand averages and are minimum **target and** threshold **habitat** values and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum **target and** threshold **habitat** values should be reduced below **target and** threshold values unless a districtwide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting **target and** threshold values. Management should be designed to create minimum **target and** threshold **habitat** conditions on project areas where there is a deficit of stands simultaneously meeting

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
larger landscape analysis shows there is a surplus. This table has been modified to contain only information pertinent to the Coconino NF. (Coconino NF forest plan, pp. 65-3 to 65-5).	minimum **target and** threshold **habitat** conditions unless the districtwide or larger landscape analysis shows there is a surplus. This table has been modified to contain only information pertinent to the Coconino NF.

Variable	Mixed Conifer All RU	Mixed Conifer Other RU*	Pine-Oak Target and Threshold Habitat**
Restricted Area Percent	10%	+15%	**Up to** 10%
Stand Averages for:			
Basal Area	170	150	**110–150**
18 inch+ trees/acre	20	20	20
Oak Basal Area	NA	NA	20
Percent total existing:			
12–18 inches	10	10	15
18–24 inches	10	10	15
24+ inches	10	10	15

Attempt to mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes, into management prescriptions (Coconino NF forest plan, page 65-4).	No Change
Maintain all species of native trees in the landscape including early seral species (Coconino NF forest plan, page 65-4).	No Change
Allow natural canopy gap processes to occur, thus producing horizontal variation in stand structure (Coconino NF forest plan, page 65-4).	No Change
Emphasize uneven-aged management systems. However, both even-aged and uneven-aged systems may be used where appropriate to provide variation in existing stand structure and species diversity. Existing stand conditions will determine which system is appropriate (Coconino NF forest plan, page 65-4).	No Change
Extend rotation ages for even-aged stands to greater than 200 years. Silvicultural prescriptions should explicitly state when vegetative manipulation will cease until rotation age is reached (Coconino NF forest plan, page 65-4).	No Change
Save all trees greater than 24 inches d.b.h. In pine-oak forests, retain existing large oaks and promote growth of additional large oaks (Coconino NF forest plan, page 65-4).	No Change

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
In pine-oak forests, retain existing large oaks and promote growth of additional large oaks (Coconino NF forest plan, page 65-4).	No Change
Encourage prescribed and prescribed natural fire to reduce hazardous fuel accumulation. Thinning from below may be desirable or necessary before burning to reduce ladder fuels and the risk of crown fire (Coconino NF forest plan, page 65-4).	No Change
Retain substantive amounts of key habitat components: • Snags 18 inches in diameter and larger • Down logs over 12 inches midpoint diameter • Hardwoods for retention, recruitment, and replacement of large hardwoods	No Change
Riparian Areas – No Change	
Domestic Livestock Grazing – No Change	
Old-Growth – No Change	
Other Forest and Woodland Types – No Change	
Guidelines for Specific Recovery Units – No Change	
Monitoring Guidelines	
Monitoring and evaluation should be collaboratively planned and coordinated with involvement from each national forest, USFWS Ecological Services Field Office, USFWS Regional Office, USFS Regional Office, Rocky Mountain Research Station, recovery team, and recovery unit working groups.	**See "Standards" for Monitoring Direction**
Population monitoring should be a collaborative effort with participation of all appropriate resource agencies. (Coconino NF forest plan, page 65-6)	
Habitat monitoring of gross habitat changes should be a collaborative effort of all appropriate resource agencies. (Coconino NF forest plan, page 65-6)	
Habitat monitoring of treatment effects (pre- and post-treatment) should be done by the agency conducting the treatment. (Coconino NF forest plan, page 65-6)	
Prepare an annual monitoring and evaluation report covering all levels of monitoring done in the previous year. The annual report should be forwarded to the Regional Forester with copies provided to the recovery unit working groups, USFWS Ecological Services field offices, and the USFWS Regional Office (Coconino NF forest plan,	

Current Coconino NF Forest Plan Direction	Proposed New Standard or Guideline Language*
page 65-6).	
Rangewide: Track gross changes in acres of owl habitat resulting from natural and human caused disturbances. Acreage changes in vegetation composition, structure, and density should be tracked, evaluated, and reported. Remote sensing techniques should provide an adequate level of accuracy (Coconino NF forest plan, page 65-6). In protected and restricted areas where silvicultural or fire abatement treatments are planned, monitor treated stands pre- and post-treatment to determine changes and trajectories in fuel levels; snag basal areas; live tree basal areas; volume of down logs over 12 inches in diameter; and basal area of hardwood trees over 10 inches in diameter at the root crown (Coconino NF forest plan, page 65-6).	
Upper Gila Mountain, Basin and Range East, and Basin and Range West Recovery Units: Assist the recovery team and recovery unit working groups to establish sampling units consisting of 19 to 39 square mile quadrats randomly allocated to habitat strata. Quadrats should be defined based on ecological boundaries such as ridge lines and watersheds. Quadrat boundaries should not traverse owl territories. Twenty percent of the quadrats will be replaced each year at random. Using the sample quadrats, monitor the number of territorial individuals and pairs per quadrat; reproduction; apparent survival; recruitment; and age structure. Track population density both per quadrat and habitat stratum.	**See "Standards" for Monitoring Direction**

* Edited and new/added text is **bolded.**

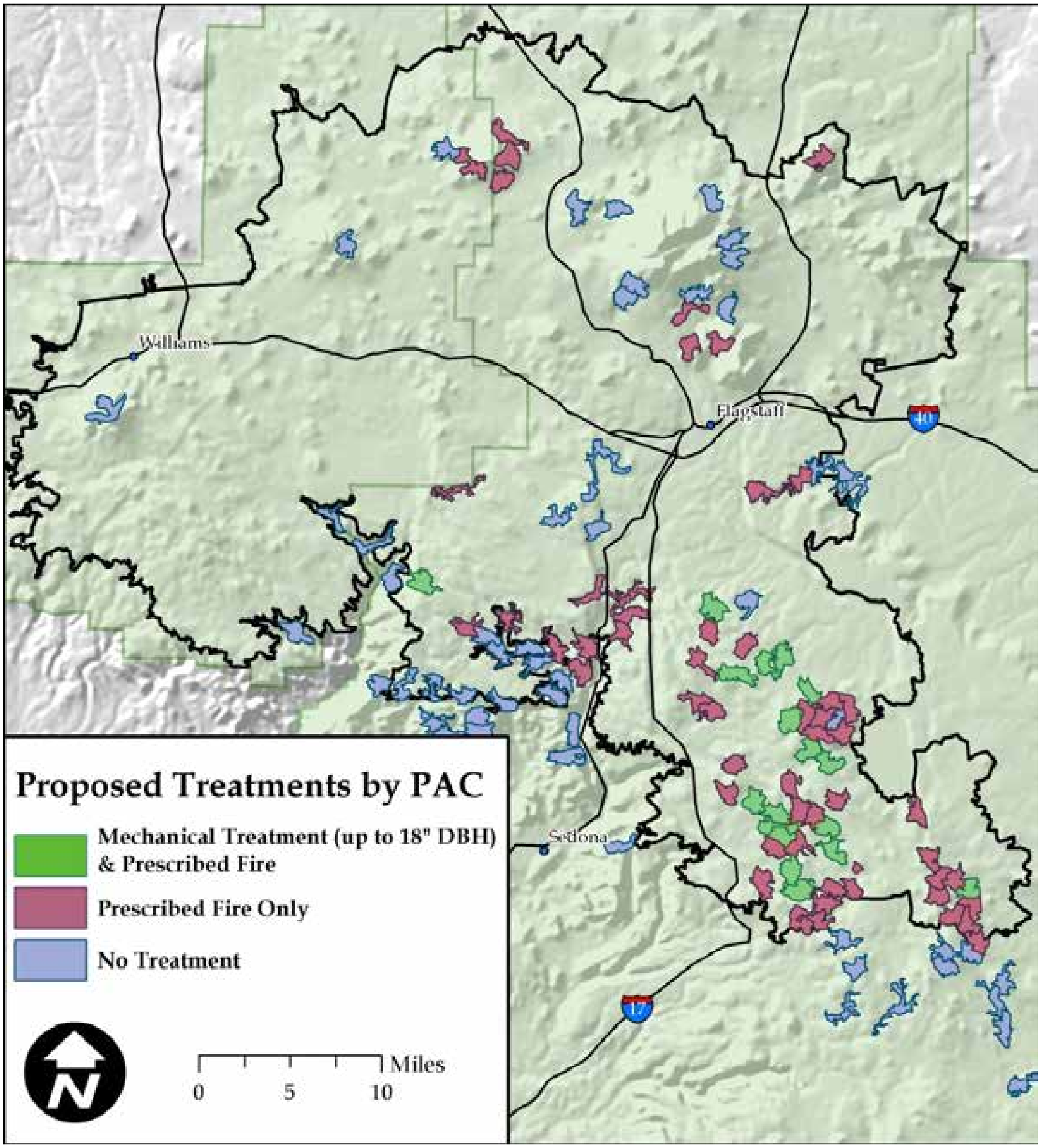

Figure 58. Alternative C amendment 1 proposed activities in MSO PACs in relation to no treatment areas (Coconino NF)

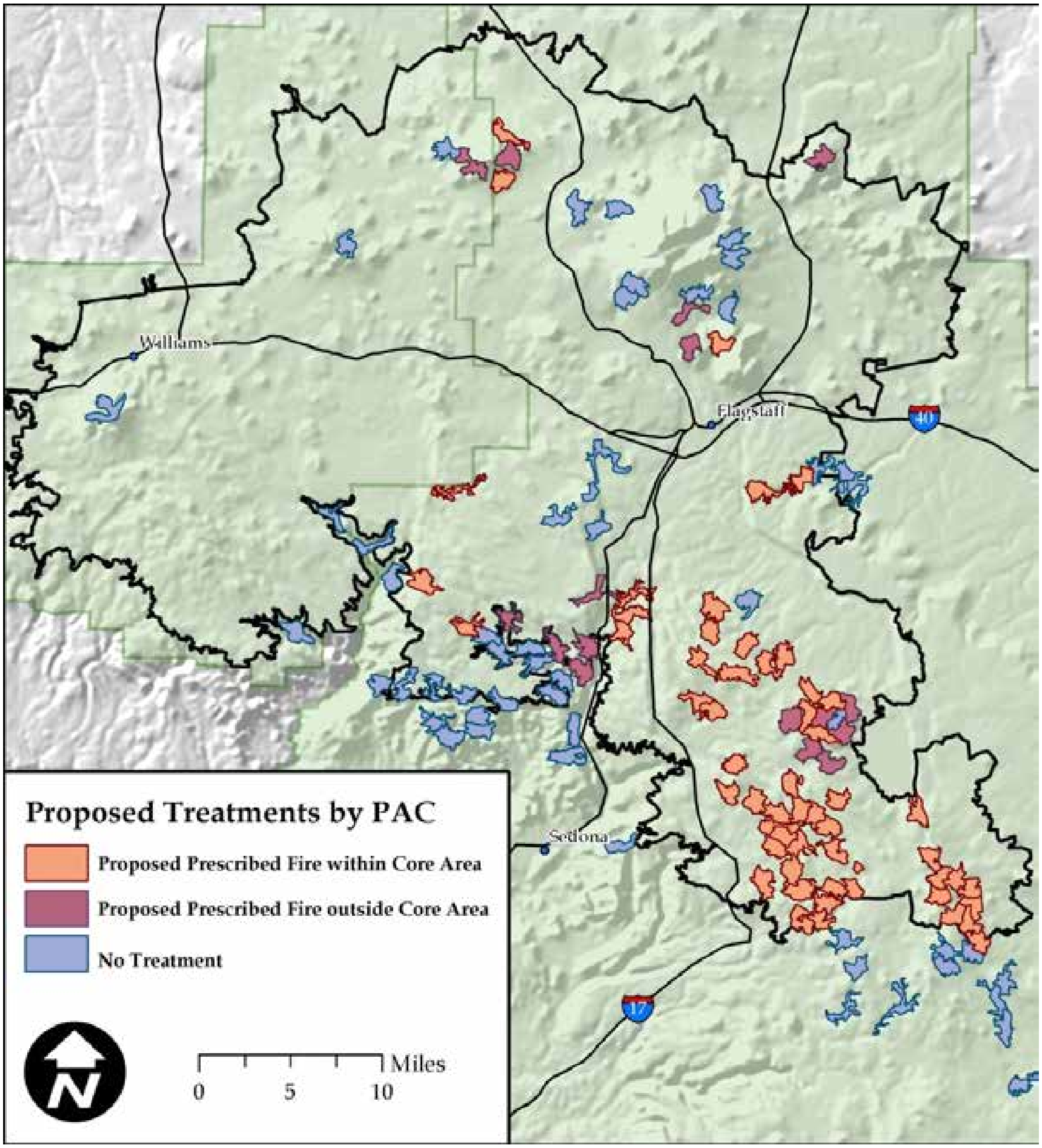

Figure 59. Alternative C amendment 1 prescribed fire within and outside of MSO core areas

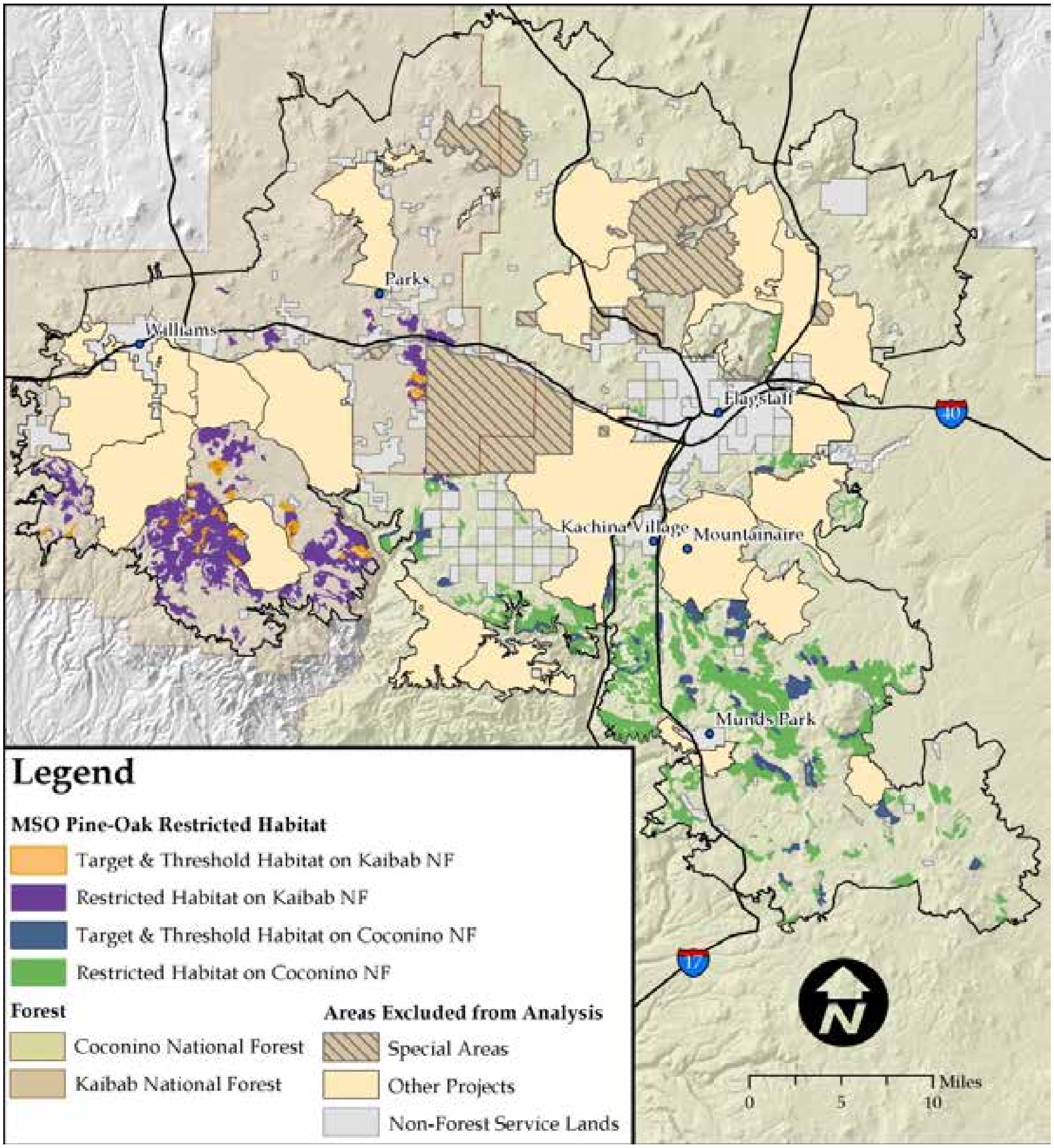

Figure 60. Alternative C amendment 1 landscape target and threshold analysis

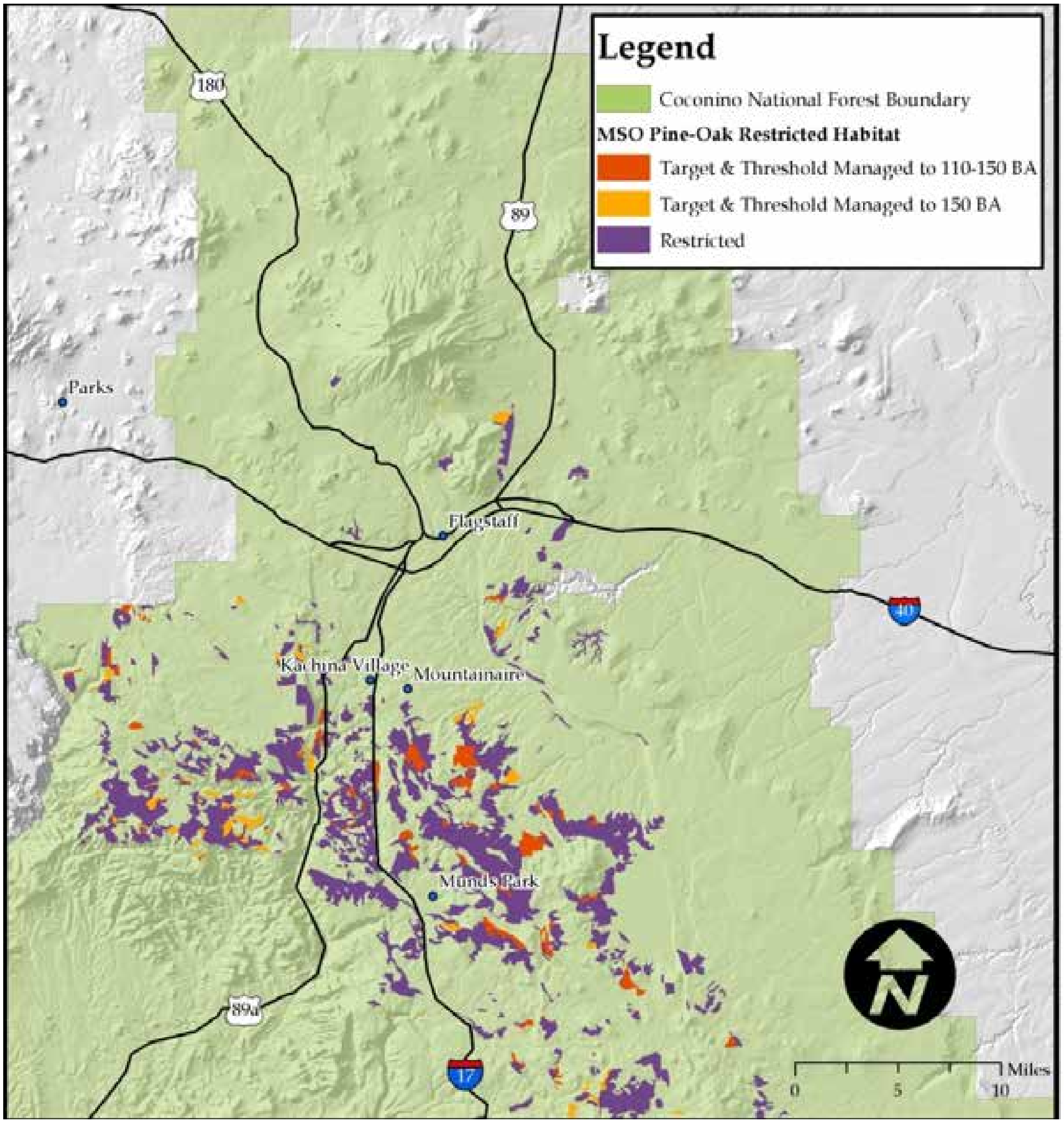

Figure 61. Alternative C amendment 1 general locations of MSO target and threshold habitat managed from 110 to 150 basal area (Coconino NF)

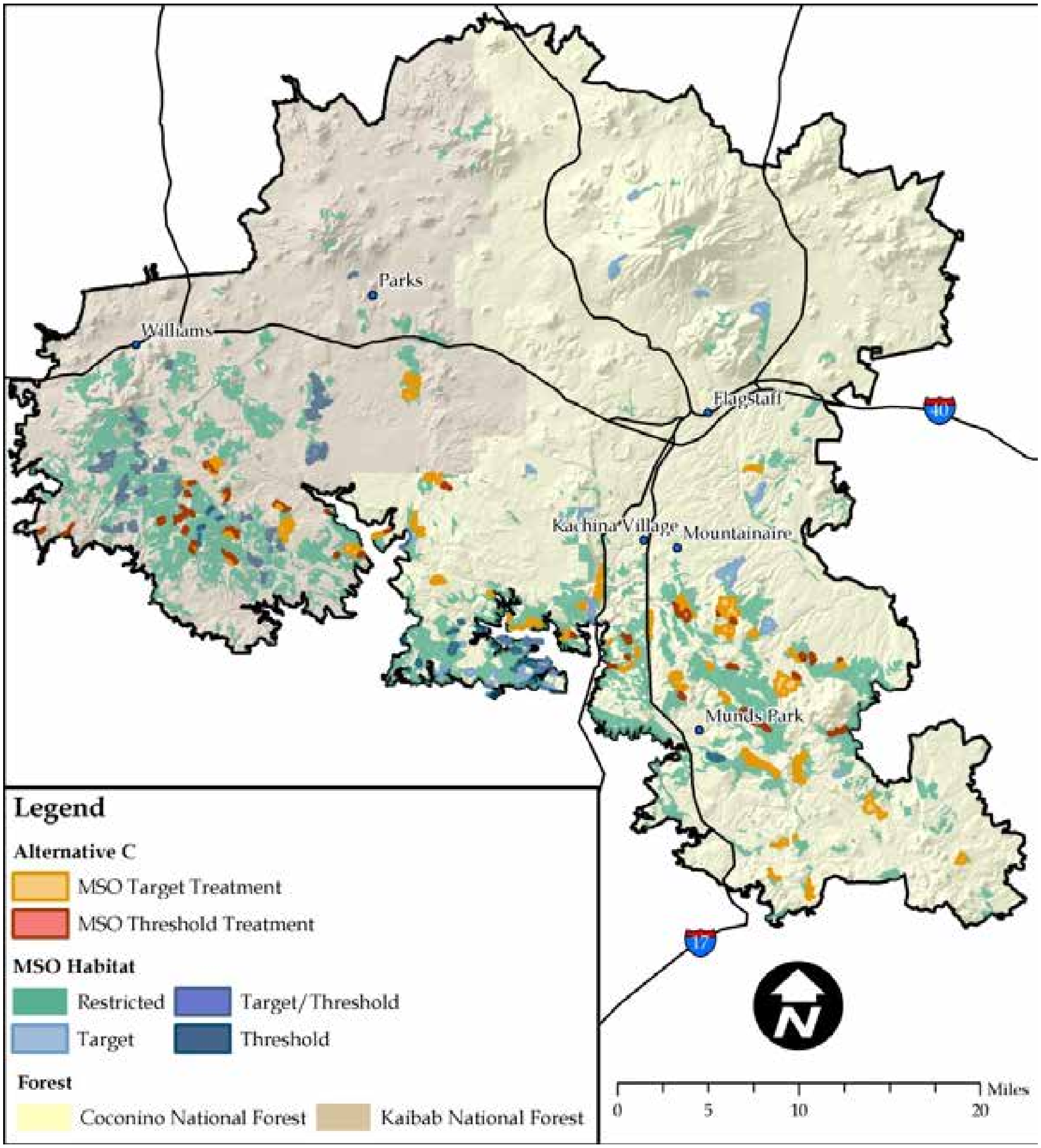

Figure 62. Alternative C amendment 1 locations of MSO target and threshold treatments

Consistency with the MSO Recovery Plan

Mechanical treatment up to 18-inch d.b.h. in select MSO PACs is consistent with the 1995 MSO recovery plan which is incorporated into the forest plan. The plan describes "large trees" as either greater than 18-inch d.b.h. (page 92) or greater than 19 inches (page 65) (USDI 1995). Treatments are also consistent with the definition of large trees in the 2012 revised MSO recovery plan.

Use of prescribed fire within MSO PAC core areas: By definition, PAC habitat and especially core areas have high fuel loading and the uncharacteristic accumulation of ground fuels puts them at further risk. Reducing fuels to reduce the risk of high-severity fire in these important habitats would contribute toward conservation of this threatened species. A forest plan variance (allowing low intensity prescribed burning within the 100-acre core area) would eliminate the need for hand line and/or dozer line construction, allow for the maximum number of surrounding PAC acres to be treated with prescribed fire, and would potentially minimize up to 560 acres of ground disturbance to PAC habitat.

The 1995 recovery plan (USDI 1995) states "Two primary reasons were cited for the listing: historical alteration of its habitat as the result of timber management practices, specifically the use of even-aged silviculture…" and "The danger of catastrophic wildfire…" While the recovery plan is clear that the primary existing threat is high-severity wildland fire, the recovery plan also states that "[r]etaining large trees is desirable because they are impossible to replace quickly and because they are common features of nesting and roosting habitats for the owl." The recovery plan recognizes that "ecosystems are temporally dynamic [and] provisions are needed to ensure owl habitat in the long term." The primary objective to be achieved by the recovery plan guidelines is protection of the best available habitat for the MSO, while maintaining sufficient flexibility for land managers to abate high fire risks and to improve habitat conditions for the owl and its prey (page 89). The potential for using silviculture as a tool for meeting objectives such as maintaining and developing MSO habitat and enhancing various ecological factors is specifically identified in the recovery plan.

The original recovery plan recommends that recovery efforts concentrate on the recovery units with the highest owl populations and where significant threats exist. The project is located within the Upper Gila Mountain Recovery Unit (UGM RU). The UGM RU contains the largest known number of MSOs with approximately 55 percent of known spotted owl territories. The major land use within this recovery unit has been timber harvest.

The (1995) recovery plan describes a change in the size class distribution of trees that occurred on commercial forest lands in Arizona and New Mexico between the 1960s and 1980s. The density of large trees (greater than 19-inch d.b.h.) decreased by 20 percent and sapling-sized trees (1- to 4.9-inch d.b.h.) decreased in both absolute density and in relative contribution to the size class distribution. Trees 5- to 12.9-inch d.b.h. increased in density by 40 percent and in relative proportion of the size class distribution, and trees 13- to 19-inch d.b.h. increased in density but not in the relative proportion of the tree distribution. The decrease in large trees was described as "an alarming negative trend with respect to a very critical component of spotted owl habitat" (page 68) given that "the basis to maintain owl populations is to ensure that adequate habitat quality and quantity will be sustained through time." In order to achieve this, the recovery plan advocates using coarse and fine filters for ecosystem management.

Coarse filters should be used "to maintain the natural array of conditions that exist with the biotic and physical limits of the landscape" while fine filters may be used "to provide specialized habitats or habitat elements within that overall landscape." They recommend "innovative applications of uneven-aged management" for developing and maintaining important but difficult to replace spotted owl habitat elements, including large pine and oak trees, and key habitat components such as trees greater than 24-inch d.b.h. and prey habitat. The amendment allows for using silvicultural and prescribed fire treatments in select PACs at risk of losing key MSO habitat elements through declining forest health. Treatment objectives are to develop and maintain adequate MSO habitat quality and quantity through time.

The need to evolve from managing solely for firewood collection and fire risk abatement is reflected in the revised recovery plan for the MSO. The revised recovery plan states “Management is the most conservatively oriented toward owl management within PACs, but is by no means ‘hands off.’ The draft recognizes situations exist where management is needed to sustain or enhance desired future conditions for the owl...” It goes on to state “Mechanical treatments to achieve these objectives require a landscape analysis to determine where the needs are greatest” which is the process we are currently undergoing (USDI 2012).

Managing up to 10 percent restricted habitat as target or threshold habitat and 110 to 150 Basal Area:

Target and Threshold Habitat: This amendment would allow for managing up to10 percent of the designated restricted habitat as nest and roost habitat. MSO habitat is generally more abundant, more contiguous, and of higher quality on the Coconino NF than the Kaibab NF. This conclusion is based on forest data queries, years of on-the-ground experience of participants in the development of the restricted layer, and on presumed choices made by the owls themselves. MSOs are abundant and concentrated in pine-oak habitat on the Coconino NF. In contrast, there is only a single MSO detection dating from 1994 in pine-oak habitat on the Kaibab NF.

The MSO recovery plan describes past planning as operating at “limited spatial scale[s]” which precludes a more meaningful review of MSO habitat at ecological scales (USDI 1995). The scale of the 4FRI and the fact it transcends administrative boundaries allows managers to conduct a true landscape-scale analysis. Overall, about 11.5 percent (8,713 acres) of the 4FRI restricted habitat would be managed as current or future target or threshold habitat. On the Coconino NF portion of the project, where the most owls and the most MSO habitat occurs, 13 percent (6,465 acres) of the restricted layer would be designated as target or threshold habitat. The Kaibab NF portion of the 4FRI treatment area would have 8 percent (2,247 acres) of the restricted layer designated as target or threshold habitat. By creating more future nesting and roosting habitat on the Coconino NF, future MSO habitat would be more contiguous for dispersing MSOs, and occur in areas supporting higher densities of MSOs than if 10 percent of the restricted layer was designated by individual administrative boundaries.

This amendment meets the intent of the original (1995) and revised (2012) recovery plan by reducing the potential for creating excessively fragmented habitat and managing stands based on their capability to attain desired stand conditions. This amendment does not affect habitat designated in previous projects or in mixed-conifer habitat.

Basal Area of 110 to 150: Use of the best science is fundamental to achieving or moving toward a restored landscape. The 1995 recovery plan (USDI 1995) puts an emphasis on “the danger of catastrophic wildfire” and additionally states that “[r]etaining large trees is desirable because they are impossible to replace quickly and because they are common features of nesting and roosting habitats for the owl.”

Managing for forest densities below 150 BA would better achieve both objectives. Management of forested ecosystems also needs to address forest health problems, return forested ecosystems to conditions within their natural range of variation, and work toward sustainable and resilient ecosystems (USDI 1995). Managing for conditions below 150 BA immediately after treatment would better meet each of the respective objectives. Finally, the recovery plan recommends managers concentrate efforts on the recovery units with the highest owl populations and where significant threats exist, both of which fit the Upper Gila Mountain Recovery Unit where the 4FRI takes place. Managing for 110 to 150 basal area is consistent with the recommendations found in the revised MSO recovery plan (USDI 2012).

Significance Evaluation

Per FSM 1926.51, changes to the land management plan that are not significant can result from:

1. Actions that do not significantly alter the multiple-use goals and objectives for long term land and resource management.
2. Adjustments of management area boundaries or management prescriptions resulting from further onsite analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long term land and resource management.
3. Minor changes in standards and guidelines.
4. Opportunities for additional projects or activities that will contribute to achievement of the management prescription.

Per FSM 1926.52, circumstances that may cause a significant change to a land management plan include:

1. Changes that would significantly alter the long-term relationship between levels of multiple-use goods and services originally projected (see section 219.10(e) of the planning regulations in effect before November 9, 2000 (see 36 CFR parts 200 to 299, revised as of July 1, 2000)), and
2. Changes that may have an important effect on the entire land management plan or affect land and resources throughout a large portion of the planning area during the planning period.

Analysis demonstrated that the proposed amendment is nonsignificant (FSM 1926.51) because the actions would not measurably alter the multiple-use goals and objectives for long term land and resource management and the actions. How actions could potentially affect timing, location and size, relationship to forest goals, objectives, outputs, and management prescriptions was evaluated.

Timing: In terms of timing, the forest plan has been in place and amended several times since 1987, and revision efforts are underway. The forest plan incorporated direction (via an amendment) from the Forest Service Southwestern Region's 1996 "Amendment of Forest Plans Record of Decision" (USDA 1996).). The actions allowed via the amendment are consistent with existing forest plan direction in that it improves nesting and rooting habitat, reduces the risk of loss from fire, and will comply with the site-specific treatment and monitoring requirements in the FWS biological opinion. Forest plan direction may be amended to incorporate the revised MSO recovery plan (USDI 2012) which recognizes that habitat restoration, in addition to the reduction of fire risk, is key to improving habitat quality.

Location and Size: There are 168 MSO PACs (117,636 acres) occurring entirely on the Coconino NF. The amendment (including mechanical treatment up to 18 inch and prescribed fire in 56 core areas) would affect 18 (11 percent) of all Coconino NF PACs. Prescribed burning within 56 core areas would potentially equal a minimum of about 5,600 acres of ground disturbance (100 acres per PAC) within 56 PACs.

Changing the minimum basal area value in restricted habitat would only apply to target and threshold acres, or those restricted acres being managed for nesting/roosting habitat as defined in the forest plans. A maximum of about 6,321 acres of restricted target or threshold habitat, or approximately 8 percent of all MSO restricted habitat (76,091acres) would be affected by using a basal area range of 110 to 150 within the treatment area on both the Coconino and Kaibab NFs.

Relationship to Forest Goals and Objectives: The amendment is consistent with forest plan goals for wildlife and fish of managing habitat to maintain viable populations of wildlife and fish species, and improving habitat for selected species (Coconino National Forest plan, replacement page 22-1). It is consistent with the goal to improve habitat for listed threatened, endangered, or sensitive species of plants and animals, and other species as they become threatened or endangered (Coconino National Forest plan, replacement page 23). The amendment is consistent with goals and objectives by protecting conditions and structures used by MSOs where they exist and to set other stands on a trajectory to grow into replacement nest habitat or to provide conditions for foraging and dispersal (USDI 1995, 2012).

Relationship to Management Prescriptions: Mechanical thinning up to 18-inch d.b.h. in 18 MSO PACs would affect between 1 and 3 percent of the forestwide MA acres (table 102). Using prescribed fire within 56 MSO PAC core areas (about 5,600 acres) would affect between 1 and 5 percent of the forestwide MA acres. Managing 6,321 acres of restricted habitat to a range of 110 to 150 BA would affect less than 1 percent to 3 percent of the forestwide MAs. The amendment intent is consistent with the management emphasis of providing for multiple uses that includes wildlife habitat and meeting MSO standards and guidelines which emphasize improving and maintaining the quality of the habitat (MA 3) and moving ponderosa pine toward desired forest structure, including northern goshawk and MSO habitats (MA 35).

Table 102. Alternative C MSO amendment 1 management area acres

MA	MA Description	Forestwide Acres	Proposed Amendment Acres	Forestwide Acres Affected (Percent)
Mechanical Treatment Up to 18-inch d.b.h.				
MA 3	Ponderosa pine below 40 percent slopes	511,015	5,384	1
MA 35	Lake Mary watershed	62,536	1,782	3
MA 4, 10, 5, 9, 12, and 6	See chapter 1, table 14	307,011	187	<1
Prescribed Fire within 56 MSO PAC Core Areas				
MA 3	Ponderosa pine below 40 percent slopes	511,015	3,800	1
MA 35	Lake Mary watershed	62,536	1,614	3
MA 5	Aspen	3,450	186	5

MA	MA Description	Forestwide Acres	Proposed Amendment Acres	Forestwide Acres Affected (Percent)
110 to 150 Basal Area in MSO Restricted Habitat				
MA 3	Ponderosa pine below 40 percent slopes	511,015	3,956	1
MA 35	Lake Mary watershed	62,536	1,926	3
MA 37 and MA 38	Walnut Canyon and West	20,566 to 36,298	312	<1
Various MAs	Various		127	

Relationship to Outputs: Outputs identified in the forest plan are associated with MMBF of sawtimber sales and products (meet demand for timber while reducing conflict with other resources), MMBF of firewood sold and free use (provide access to firewood), grazing capacity (MAUM), and permitted livestock use (MAUM).The amendment would not affect outputs or change the long-term relationship between levels of goods (timber, firewood) and services. Due to the minimal acres affected, the amendment would not alter outputs on a forestwide basis or change the long-term relationship between levels of goods (timber, firewood) and services.

In comparison the forest's total suitable timber lands (626,326 acres), the amendment would affect about 1 percent of those lands. For this reason, mechanical treatment within PACs and the minimal (6,465) acres treated in restricted habitat do not measurably increase or decrease timber outputs or firewood availability. There would be no measurable effect to outputs on a forestwide basis or the long-term relationship between levels of goods (timber, firewood) and services from using prescribed fire in 56 core areas, managing restricted habitat up to 10 percent, managing restricted habitat for a basal area of 110 to 150, or deferring the final design of treatments and monitoring to the project's biological opinion. The amendment would not affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use.

Amendment 2. Management of Canopy Cover and Ponderosa Pine with an Open Reference Condition Within Goshawk Habitat (Coconino NF)

Amendment 2 is a specific, one-time variance for the Coconino NF restoration project. Once the project is complete, current forest plan direction would apply to the project area. The language proposed does not apply to any other forest project. The amendments would be authorized per direction in the National Forest Management Act of 1976 (NFMA) and its implementing regulations found in 36 CFR 219 (1982).

Amendment Description

In the "Vegetation Management – Landscapes Outside Goshawk Post-fledgling Family Areas" and "Vegetation Management –Within Post-fledgling Family Areas" section of the forest plan, a site-specific, nonsignificant plan amendment would: (1) add the desired percentage of interspace within uneven-aged stands to facilitate restoration, (2) add the interspace distance between tree groups, (3) add language clarifying where canopy cover is and is not measured, (4) allow 29,017 acres to be managed for an open reference condition which affects canopy cover guidelines for VSS 4 through VSS 6 groups and reserve trees, and (5) add a definition to the forest plan glossary for the terms interspaces, open reference condition, and stands.

The forest plan directs projects to manage for uneven-aged stand conditions within goshawk habitat. Forested groups consist of an interspersion of six vegetation structural stages (VSS 1 to VSS 6). For the purposes of this amendment, the following definitions apply:

- **Stands** are defined as a contiguous area of trees sufficiently uniform in forest type, composition, structure, and age class distribution, growing on a site of sufficiently uniform conditions to be a distinguishable unit. Four classification characteristics are generally used to distinguish forest stands: biophysical site (soils, aspect, elevation, plant community association, climate, etc.), species composition, structure (density, and age (1-aged, 2-aged, uneven-aged)), and management emphasis (administrative requirements and local management emphasis that will shape structure over time). Based upon Agency guidelines, the minimum stand mapping size is 10 acres.
- **Interspaces** are defined as the open space between tree groups intended to be managed for grass/forb/shrub vegetation during the long term. Interspaces may include scattered single trees.
- **Open reference condition** is defined as forested ponderosa pine areas with mollic-integrade soils to be managed as a relatively open forest with trees typically aggregated in small groups within a grass/forb/shrub matrix.

Background

Canopy cover is defined as “the percentage of a fixed area covered by the crowns of plants delimited by a vertical projection of the outermost perimeter of the spread of foliage” (Reynolds et al. 1992). Obtaining consistent results has been difficult; even the definition of the term is dependent on the method of measurement. To resolve this issue, the Forest Service used the Forest Vegetation Simulation (FVS) crown width model as the basis for developing stocking densities that would achieve desired canopy cover levels.

The forest plan directs projects to measure “vertical crown projection on average across the landscape” (see Coconino National Forest plan, page 65-9). Whereas the forest plan clearly provides direction for meeting minimum canopy cover percentages in VSS 4 to 6, the plans lack explicit language for measuring canopy cover. Although the forest plan provides direction and desired conditions for the vegetation structural stages, the forest plan does not describe the relationship between nonforested areas (interspace) and natural openings across the landscape.

Nonforested areas (interspaces) occur between individual trees, tree clumps, and tree groups. These nonforested areas (interspaces) are not equivalent to VSS 1. Whereas VSS 1 may provide openings in the short term, this structural stage is expected to regenerate tree cover in the long term. Refer to the silviculture report and the implementation plan (appendix D) which provides minimum stocking guidelines that have been developed to assure canopy cover requirements are met. Figure 63 displays the general locations in alternative C where canopy cover would be affected by the amendment on both forests. Figure 64 displays the general locations in alternative C where acres would be managed for an open reference condition on both forests.

Approximately 198,136 acres (61 percent) of the forested areas (within the project area) have an open reference condition that corresponds to mollic-integrade soils. The desired condition is to have a portion of these acres (29,017 acres) managed as a relatively open forest with trees typically aggregated in small groups within a grass/forb/shrub matrix (Woolsey 1911, Cooper 1960, White 1985, Pearson 1950, Covington et a1.1997, Abella and Denton 2009). See the soils specialist report for detailed information.

Current forest plan language and edited or added/new text is **bolded** in table 103.

Table 103. Alternative C amendment 2 management of canopy cover and ponderosa pine with an open reference condition in goshawk habitat (Coconino NF)

Current Coconino NF Forest Plan Direction	Proposed New Guideline Language*
Landscapes Outside Goshawk PFAs	
No similar direction in forest plan	**General: Within ponderosa pine stands, manage over time for uneven-aged stand conditions composed of heterogeneous mosaics of tree groups and single trees, with interspaces between tree groups. The size of tree groups, as well as sizes and shapes of interspaces, should be variable. Over time, the spatial location of the tree groups and interspaces may shift within the uneven-aged stand.**
General: The distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir forests is 10% grass/forb/shrub (VSS 1), 10% seedling-sapling (VSS 2), 20% young forest (VSS 3), 20% mid-aged forest (VSS 4), 20% mature forest (VSS 5), 20% old forest (VSS 6). NOTE: The specified percentages are a guide and actual percentages are expected to vary + or – up to 3% (Coconino NF forest plan, p. 65-9).	General: **For the areas managed for tree crown development**, the distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir forests is 10 percent grass/forb/shrub (VSS 1), 10 percent seedling-sapling (VSS 2), 20 percent young forest (VSS 3), 20 percent mid-aged forest (VSS 4), 20 percent mature forest (VSS 5), and 20 percent old forest (VSS 6). Note: the specified percentages are a guide, and actual percentages are expected to vary plus or minus up to 3 percent.
The distribution of VSS, tree density, and tree age are a product of site quality in the ecosystem management area. Use site quality to guide in the distribution of VSS, tree density, and tree ages. Use site quality to identify and manage dispersal PFA and nest habitat at 2 - 2.5 mile spacing across the landscape (Coconino NF forest plan, p. 65-9).	No Change
Snags are 18" or larger d.b.h. and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape (Coconino NF forest plan, p. 65-9).	Snags are 18" or larger d.b.h. and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, **canopy cover as defined by vertical crown projection is evaluated within mid-aged to old forest vegetation structural stage groups (VSS 4, 5, and 6).**
No corresponding forest plan direction	**Develop and maintain a highly diverse vegetation mosaic: 30 to 90 percent of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns. Within areas managed for an open reference condition, 10 to 30 percent of**

Current Coconino NF Forest Plan Direction	Proposed New Guideline Language*
	the uneven-aged stand should be under ponderosa pine and deciduous tree crowns.
No corresponding forest plan direction	**Tree group spatial distribution may be highly variable based on local site and current conditions; the interspaces between groups may range from 20 to 200 feet, but generally between 25 and 100 feet apart from drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.**
No corresponding forest plan direction	**Each tree group is generally dominated by one vegetation structure stage. The spatial arrangement of trees, high dispersion of vegetation structural stage diversity, and interspaces comprise each uneven-aged forest stand. Collectively these stands aggregate to uneven-aged forest landscapes, similar to natural conditions.**
The order of preferred treatment for woody debris is: (1) prescribed burning, (2) lopping and scattering, (3) hand piling or machine grapple piling, (4) dozer piling (Coconino NF forest plan, p. 65-9).	No Change
Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stages (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stages (VSS 1, VSS 2, and VSS 3) (Coconino NF forest plan, p. 65-9).	Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stage **groups** (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stage **groups** (VSS 1, VSS 2, and VSS 3) **or in interspaces, natural meadows, grasslands, or other areas not managed for forest cover.**
Spruce-Fir: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60% and 2/3 40%, mature forest (VSS 5) should average 60+%, and old forest (VSS 6) should average 60+%. Maximum opening size is 1 acre with a maximum width of 125 feet. Provide 2 groups of reserve trees per acre with 6 trees per group when opening size exceeds 0.5. Leave at least 3 snags, 5 downed logs, and 10–15 tons of woody debris per acre (Coconino NF forest plan, p. 65-9).	No Change
Mixed Conifer: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 40+%, mature forest (VSS 5) should average 50+%, and old forest (VSS 6) should average 60+%. Maximum opening size is up to 4 acres with a maximum width of up to 200 feet. Retain 1 group of reserve trees per acre of 3–5 trees per group for openings greater than 1 acre in size. Leave at least 3 snags, 5 downed logs, and 10–15 tons of woody debris per acre (Coconino NF forest plan, p. 65-10).	No Change

Current Coconino NF Forest Plan Direction	Proposed New Guideline Language*
Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5) should average 40+%, and old forest (VSS 6) should average 40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3–5 trees per group, will be left if the opening is greater than an acre in size. Leave at least 2 snags per acre, 3 downed logs per acre, and 5–7 tons of woody debris per acre (Coconino NF forest plan, p. 65-10).	Ponderosa Pine: Canopy cover for mid-aged forest (VSS 4) should average 40+ percent, mature forest (VSS 5) should average 40+ percent, and old forest (VSS 6) should average 40+ percent. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, three to five trees per group, will be left if the **created regeneration** opening is greater than an acre in size. Leave at least two snags per acre, three downed logs per acre, and 5–7 tons of woody debris per acre. **In acres managed for an open reference condition, canopy cover guidelines for VSS 4 through VSS 6 groups do not apply. One group of reserve trees, with a minimum of one to two trees per group will be left if the interspace size is greater than an acre in size. Interspace size is up to 4 acres.** Leave at least two snags per acre, three downed logs per acre, and 5–7 tons of woody debris per acre
Woodland: manage for uneven age conditions to sustain a mosaic of vegetation densities (overstory and understory), age classes, and species composition well distributed across the landscape. Provide for reserve trees, snags, and down woody debris (Coconino NF forest plan, p. 65-10).	No Change
Vegetation Management – Within Post-fledgling Family Areas	
General: Provide for a healthy sustainable forest environment for the post-fledging family needs of goshawks. The principle difference between within the post-fledging family area and outside the post-fledging family area is the higher canopy cover within the post-fledging family area and smaller opening size within the post-fledging family area. Vegetative Structural Stage distribution and structural conditions are the same within and outside the post-fledging family area (Coconino NF forest plan, p. 65-10).	No Change
No similar direction in forest plan	**Canopy cover is evaluated at the group level within mid-aged to old forest structural stages groups (VSS 4, VSS 5, and VSS 6) and not within grass/forb/shrub to young forest structural stage groups (VSS 1, VSS 2, and VSS 3) or in interspaces, natural meadows and grasslands, or other areas not managed for forest conditions.**
Spruce-fir: Canopy Cover for mid-aged forest (VSS 4) should average 60+% and for mature (VSS 5) and old forest (VSS 6) should average 70+% (Coconino NF forest plan, p. 65-10).	No Change
Mixed Conifer: Canopy Cover for mid-aged (VSS 4) to old forest (VSS 6) should average 60+%.	No Change

Current Coconino NF Forest Plan Direction	Proposed New Guideline Language*
Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 50+%. Mature (VSS 5) and old forest (VSS 6) should average 50+% (Coconino NF forest plan, p. 65-10).	No Change
No corresponding forest plan direction	**Develop and maintain a highly diverse vegetation mosaic: 30 to 90 percent of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns.**
No corresponding forest plan direction	**Tree group spatial distribution may be highly variable based on local site and current conditions; the interspaces between groups may range from 20 to 200 feet, but generally between 25 and 100 feet apart from drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.**
No corresponding forest plan direction	**Each tree group is generally dominated by one vegetation structure stage. The spatial arrangement of trees, high dispersion of VSS structural stage diversity, and interspaces comprise each uneven-aged forest stand. Collectively these stands aggregate to uneven-aged forest landscapes, similar to natural conditions.**
Glossary	
No corresponding forest plan language	**Interspaces: The open space between tree groups intended to be managed for grass/forb/shrub vegetation during the long term. Interspaces may include scattered single trees.**
No corresponding forest plan language	**Open reference condition: Forested ponderosa pine areas with mollic-integrade soils to be managed as a relatively open forest with trees typically aggregated in small groups within a grass/forb/shrub matrix.**
No corresponding forest plan language	**Stands: Contiguous area of trees sufficiently uniform in forest type, composition, structure, and age class distribution, growing on a site of sufficiently uniform conditions to be a distinguishable unit.**

* Edited and new/added text is **bolded.**

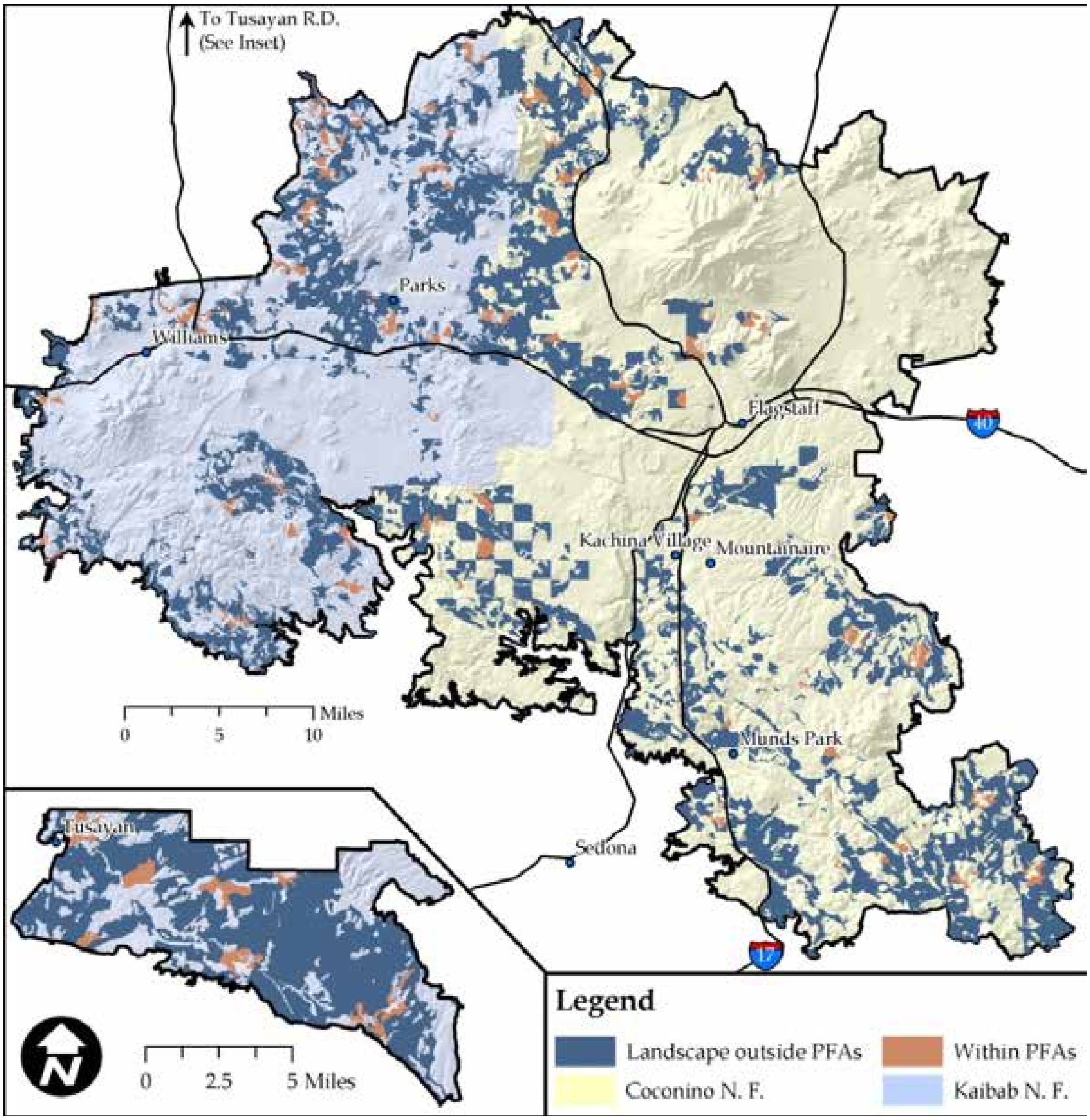

Figure 63. Alternative C general location of goshawk habitat subject to canopy cover requirements in VSS 4 to VSS 6 (Coconino NF and Kaibab NF)

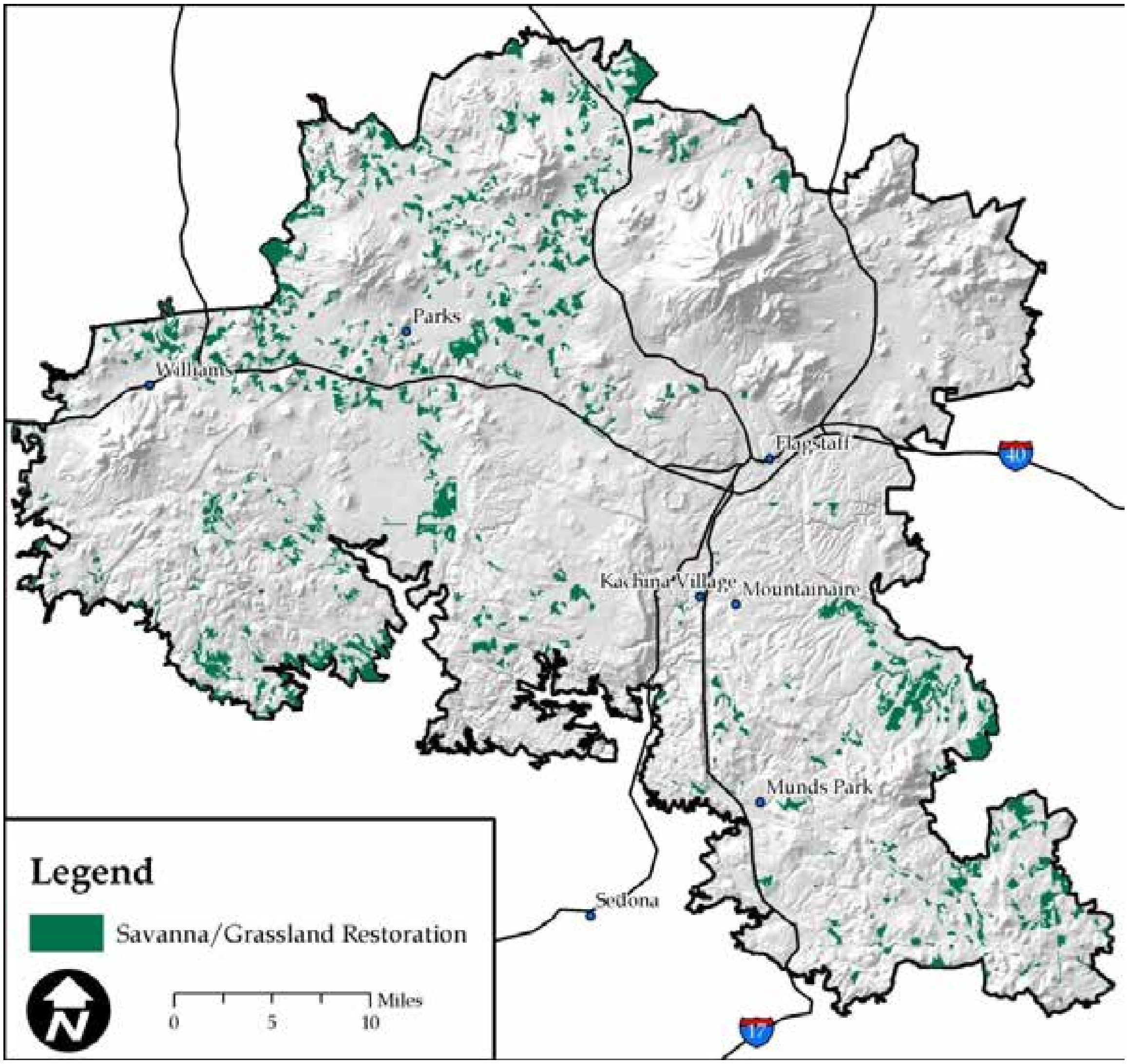

Figure 64. Alternative C amendment 2 general locations of savanna and grassland restoration treatments (Coconino NF and Kaibab NF)

Significance Evaluation

Per FSM 1926.51, changes to the land management plan that are not significant can result from:

1. Actions that do not significantly alter the multiple-use goals and objectives for long-term land and resource management.
2. Adjustments of management area boundaries or management prescriptions resulting from further onsite analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long term land and resource management.
3. Minor changes in standards and guidelines.
4. Opportunities for additional projects or activities that will contribute to achievement of the management prescription.

Per FSM 1926.52, circumstances that may cause a significant change to a land management plan include:

1. Changes that would significantly alter the long-term relationship between levels of multiple-use goods and services originally projected (see section 219.10(e) of the planning regulations in effect before November 9, 2000 (see 36 CFR parts 200 to 299, revised as of July 1, 2000)), and
2. Changes that may have an important effect on the entire land management plan or affect land and resources throughout a large portion of the planning area during the planning period.

Analysis demonstrated that the proposed amendment is nonsignificant (FSM 1926.51) because the actions would not significantly alter the multiple-use goals and objectives for long term land and resource management and the actions. How actions could potentially affect timing, location and size, relationship to forest goals, objectives, outputs, and management prescriptions was evaluated.

Timing: In terms of timing, the forest plan has been in place (and amended) since 1987 and plan revision efforts are underway.

Location and Size: Suitable goshawk habitat on the Coconino NF encompasses about 791,897 acres (Green 2011, draft unpublished data). Approximately 399,633 acres of goshawk habitat is within the 4FRI project area.

- The canopy cover portion of the amendment would affect 139,161 acres (18 percent) of all goshawk habitat on the Coconino NF and about 35 percent of goshawk habitat within the project area. For this reason, location (confined to the ponderosa pine cover type) and size was determined to be non-significant.
- Managing 29,017 acres of ponderosa pine for an open reference condition would affect approximately 4 percent of all suitable goshawk habitats on the forest and about 8 percent of goshawk habitat within the project area.

For these reasons, location and size was determined to be nonsignificant. The amendment would facilitate moving over 139,000 acres toward the desired forest structure (groups and clumps with herbaceous openings) that maximizes prey base species habitat and allows for the reintroduction of fire into the ecosystem; and moves over 29,000 acres toward historic reference conditions.

Relationship to Forest Goals and Objectives: Alternative C would meet goshawk forest plan canopy cover requirements in VSS 4 to 6 in all acres except the 29,054 acres managed for an open reference condition. In all acres but the open reference condition acres, actions would move toward the desired VSS size class distribution.

The amendment is consistent with forest goals for wildlife and fish of managing habitat to maintain viable populations of wildlife and fish species and improve habitat for selected species (Coconino National Forest plan, replacement page 22-1). It is consistent with the goal to improve habitat for listed threatened, endangered, or sensitive species of plants and animals and other species as they become threatened or endangered (Coconino National Forest plan, replacement page 23).

Relationship to Management Prescriptions: Table 104 displays the acres associated with Coconino NF management areas (MAs).

Canopy Cover: The acres of forestwide MAs affected by the canopy cover portion of the amendment (139,161 acres total) would range from 3 percent (MA 4) to 35 percent (MA 38). The amendment is specific to this project and would not impose definition and clarification requirements on the future management of canopy cover within goshawk habitat.

Open Reference Condition: The acres of forestwide MAs affected by the open reference condition portion of the amendment (29,054 acres total) would range from 1 percent (MA 10) to 9 percent (MA 35). The amendment is consistent with the management emphasis of providing for multiple uses that includes wildlife habitat (MA 3) and moving ponderosa pine toward desired forest structure, including northern goshawk habitats (MA 35). The amendment is specific to this project and would not impose requirements on future management of the 29,017 acres of goshawk non-PFA; however, forest plan revision decisions may.

Table 104. Alternative C Amendment 2 MA Acres

MA	MA Description	Forestwide Acres	Proposed Amendment Acres	Forestwide Acres Affected (Percent)
Canopy Cover				
MA 3	Ponderosa pine below 40 percent slopes	511,015	92,204	18
MA 35	Lake Mary watershed	62,536	14,287	23
MA 38	West	36,298	12,844	35
MA 6	Unproductive timber lands	67,146	4,929	7
MA 37	Walnut Canyon	20,566	4,536	22
MA 20	Highway 180 corridor	7,608	2,087	27
MA 4	Ponderosa pine and mixed conifer >40%	46,382	1,612	3
MA 36	Schultz	21,289	1,815	9
*MA 28, 4, 9, 5, 8, 10, 7, 34, 12, 15, 14	See chapter 1, table 14	511,301	4,847	<1
Open Reference Condition				
MA 3	Ponderosa pine below 40 percent slopes	511,015	19,010	4
MA 35	Lake Mary watershed	62,536	5,840	9
MA 10	Transition grassland	160,494	1,288	1
MA 38	West	36,298	1,073	3

MA	MA Description	Forestwide Acres	Proposed Amendment Acres	Forestwide Acres Affected (Percent)
**MA 6, 20, 4, 37, 9, 36, 7, 12, 34, 28, 5	See chapter 1, table 14	221,928	1,806	<1

*All MA acres ranging from 1 to 1,215 were aggregated into the various categories.
**All MA acres ranging from 3 to 655 were aggregated into the various categories.

Relationship to Outputs: Outputs identified in the forest plan are associated with MMBF of sawtimber sales and products (meet demand for timber while reducing conflict with other resources), MMBF of firewood sold and free use (provide access to firewood), grazing capacity (MAUM), and permitted livestock use (MAUM).The amendment would not affect outputs or change the long-term relationship between levels of goods (timber, firewood) and services.

The canopy cover portion of the amendment provides clarification and disclosure of methods for meeting forest plan requirements. It has no relationship to outputs or to the relationship between the level of goods (timber, firewood) and services and would not result in a change in land productivity or timber suitability classification.

Managing a portion of the landscape for an open reference condition affects about 29,017 acres of an estimated 626,326 acres of suitable timber lands. The management strategy on these acres would result in an extended rotation period between treatments beyond what was considered in developing the long-term sustained yield output in the forest plan. In the short term (10-year period), the amendment affects about 5 percent of the suitable land base. However, due to the minimal acres affected, the amendment would not measurably alter outputs in the foreseeable future on a forestwide basis; or change the long-term relationship between levels of goods (timber, firewood) and services. There would be no change in land productivity; therefore, it would not affect timber suitability classification.

Whether the 29,017 acres would continue to be managed as suitable timber in the long term will be evaluated during the forest plan revision process. No portion of the amendment would affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use.

Amendment 3. Effect Determination for Cultural Resources

Amendment 3 is a specific, one-time variance for the Coconino NF restoration project. Once the project is complete, current forest plan direction would apply to the project area. The language proposed does not apply to any other forest project. The amendments would be authorized per direction in the National Forest Management Act of 1976 (NFMA) and its implementing regulations found in 36 CFR 219 (1982).

Amendment Description

The amendment deletes the standard that addresses achieving a “no effect” determination and adds the words “or no adverse effect” to the remaining standard. Management strives to achieve a “no effect” or “no adverse effect” determination.

Background

The Coconino NF forest plan as written has some conflicting direction regarding managing significant or potentially significant sites. One standard (which would be amended for this project) directs management to **strive** to achieve a "no effect" determination. A second standard (which would be deleted for this project) directs management to achieve a "no effect" determination in consultation with SHPO and ACHP (36 CFR 800). An amendment is proposed to recognize that there could be effects that are not adverse, and that there could be adverse effects that may or may not be fully mitigated. Table 105 displays current and proposed forest plan language. New or edited text is displayed in **bold** text.

Table 105. Alternative C amendment 3 effect determination for cultural resources

Current Coconino NF Forest Plan Direction	Proposed New Standards and Guidelines Language*
Cultural Resources	
Consult with Native Americans when projects and activities are planned in sites or areas of known religious or cultural importance (Coconino NF forest plan, page 52).	No Change
Make boughs and herbaceous plant parts used for Native American religious and ceremonial purposes available under conditions and procedures that minimize restrictions, consistent with laws, regulations, and agreements with tribes. The written authorization to the Hopi Tribe for gathering without specific individual permits is an example. This authorization does not include such items as firewood removed from the forest or Kiva logs, which do require a permit (Coconino NF forest plan, page 52).	No Change
The forest complies with the National Historic Preservation Act (NHPA) in decisions involving interactions between cultural and other resources. Cultural resources are managed in coordination with the State Historic Preservation Plan (SHPO). Until evaluated, the minimal level of management for all sites is avoidance and protection (Coconino NF forest plan, page 52).	No change
Specific standards and guidelines derived from the settlement agreement for the Save the Jemez lawsuit are subject to adjustment, should that agreement be modified. In that event an amendment to the forest plan will be issued (Coconino NF forest plan, page 52).	No Change
Project undertakings are inventoried for cultural resources and areas of Native American religious use. Inventory intensity complies with regional policy, and the settlement agreement for the Save The Jemez Lawsuit, and is determined in consultation with the State Historic Preservation Officer (SHPO). Generally, inventory standards are: One hundred percent survey of all projects causing complete surface disturbance; When less than 100 percent survey is deemed appropriate, the specific sample fraction surveyed is determined in consultation with the State Historic Preservation Officer and is generally greater than 10 percent. Factors determining when sampling is appropriate include projects with dispersed or minimal impacts, low expected archaeological site density, ground cover, and types of archaeological sites present in the area; Consultation with appropriate Native American groups; Consultation with the SHPO, and if necessary, the Advisory Council on Historic Preservation (ACHP), before project implementation (Coconino NF forest plan, page 52-1).	No Change

Current Coconino NF Forest Plan Direction	Proposed New Standards and Guidelines Language*
Significant, or potentially significant, inventoried sites are managed to achieve a “No Effect” determination, in consultation with the SHPO and ACHP (36 CFR 800) (Coconino NF forest plan, page 53).	**Standard would be removed**
Monitoring during and after project implementation is done to document site protection and condition (Coconino NF forest plan, page 53).	No Change
Management strives to achieve a “No Effect” determination (Coconino NF forest plan, page 53).	**Management strives to achieve a “no effect” or “no adverse effect” determination**
When sample surveys, rather than 100 percent survey coverage, are done for project clearances, survey locations and sample intensity are based on areas of greatest project impact, likely locations for cultural resource sites based on archaeological experience, land management planning, dispersion of sample coverage, certain topographic features specified in the Save the Jemez lawsuit settlement agreement, and likely areas based on the Forest site density predictions (Coconino NF forest plan, page 53).	No Change
Identified sites are evaluated for their National Register eligibility when they are severely damaged, when they will be impacted by an undertaking, or information about the uniqueness, commonness, and characteristics of their site class are sufficiently known to make an informed decision. Sites for which determinations of eligibility have not been made are managed as if they are eligible, unless consultation with the SHPO indicates otherwise (Coconino NF forest plan, page 53).	No Change
For each full-time professional cultural resource specialist employed by the forest, at least two site nominations, one archaeological district nomination, or one thematic or multiple resource nomination will be made each year to the National Register of Historic Places. Or, alternatively, the forest will coordinate with other forests to prepare a joint district, thematic, or multiple resource nomination (Coconino NF forest plan, page 53).	No Change
Inventoried sites allocated to management categories, and/or eligible or potentially eligible for the NRHP or potentially eligible for the NRHP are systematically revisited by regularly scheduled patrols, and by cultural resources specialists to assess natural deterioration, vandalism, or pilfering. Inspections are made at least biannually of properties that have been listed in or nominated to the National Register. Sites most susceptible to natural deterioration and/or human disturbance are monitored frequently. Rapid natural deterioration, or susceptibility to such, requires stabilization, restoration, and/or data recovery. Vandalism or pilfering requires protective measures such as signing, remote sensing, increased patrolling, investigations, stabilization, restoration, and/or data recovery. Specific sites or areas may be closed to off-road driving and withdrawn from mineral entry. Law enforcement is planned and implemented to minimize resource damage and user conflicts. Signing is appropriate to inform and educate the public and minimize direct law enforcement activity. Aggressively pursue violations (Coconino NF forest plan, page 53).	No Change
Continue to interpret cultural resources through lectures, tours, papers, reports, publications, brochures, displays, films, trails, signs, and other opportunities. (Coconino NF forest plan, page 54).	No Change

Current Coconino NF Forest Plan Direction	Proposed New Standards and Guidelines Language*
Develop a program to complete 100 percent coverage of the Forest's cultural resource inventory by 2000 (Coconino NF forest plan, page 54).	No Change
The first priorities for cultural resources protection, enhancement, and interpretation are those sites that are easily accessible, have major interpretive potential, or are in major need of repair. Priority sites for signing are the C. Hart Merriam Base Camp, Honanki Cliff Dwellings, Elden Pueblo, Sacred Mountain, Palatki Cliff Dwellings, and Clear Creek Ruins. Priority sites for repair and stabilization are Honanki Cliff Dwellings, Palatki Cliff Dwellings, Sacred Mountain, Clear Creek Cliff Dwelling, and General Springs Cabin. Priority sites for developing interpretive brochures are Elden Pueblo, Sacred Mountain, Red Tank Draw Petroglyphs, Honanki Cliff Dwellings, Palatki Cliff Dwellings, and Clear Creek Ruins. Priorities are to: Survey to clear projects. Survey to fill in gaps in existing inventory coverage. Survey areas of known high site densities. Survey areas that would do the most to answer current archaeological questions (Coconino NF forest plan, page 54).	No Change
Computerize cultural resource site information by 1990 (Coconino NF forest plan, page 54).	No Change
Maintain a form for tracking compliance of each undertaking with the requirements of the National Historic Preservation Act (Coconino NF forest plan, page 54).	No Change
Stabilize or repair damaged National Register sites or other sites funded by regional priority (Coconino NF forest plan, page 54).	No Change
Continue to develop the Elden Pueblo Interpretive Site and the cooperative education program with the Museum of Northern Arizona (Coconino NF forest plan, page 54).	No Change
Encourage universities to conduct summer field schools to assist in cultural resource survey and excavation work and to provide the forest with scientific knowledge (Coconino NF forest plan, page 54).	No Change
Periodically focus media attention on Elden Pueblo and/or other sites to educate the public and further volunteer interest in resource management. Work with community organizations, businesses, and other agencies to promote Arizona Archaeology Week. Feature significant finds and significant damage in the media to increase public awareness of benefits and problems (Coconino NF forest plan, page 54).	No Change

* Edited and new/added text is **bolded**.

Significance Evaluation

Per FSM 1926.51, changes to the land management plan that are not significant can result from:

1. Actions that do not significantly alter the multiple-use goals and objectives for long term land and resource management.

2. Adjustments of management area boundaries or management prescriptions resulting from further onsite analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long term land and resource management.
3. Minor changes in standards and guidelines.
4. Opportunities for additional projects or activities that will contribute to achievement of the management prescription.

Per FSM 1926.52, circumstances that may cause a significant change to a land management plan include:

1. Changes that would significantly alter the long-term relationship between levels of multiple-use goods and services originally projected (see section 219.10(e) of the planning regulations in effect before November 9, 2000 (see 36 CFR parts 200 to 299, revised as of July 1, 2000)), and
2. Changes that may have an important effect on the entire land management plan or affect land and resources throughout a large portion of the planning area during the planning period.

The proposed amendment is nonsignificant (FSM 1926.51) because multiple-use goals and objectives for long term land and resource management and its actions would not be altered. How the amendment could potentially affect timing, location and size, relationship to forest goals, objectives, outputs, and management prescriptions was evaluated.

Timing: In terms of timing, the forest plan has been in place (and amended) since 1987, and plan revision efforts are underway.

Location and Size: The amendment is specific to the 593,211 acres of proposed treatments in this project. This affects about 33 percent of the Coconino NF which is about 1,821,495 acres in size. This would not have an important effect on the entire land management plan or a large portion of the planning area. For this reason, location and size was determined to be nonsignificant.

Relationship to Forest Goals and Objectives: The amendment would not affect attainment of forest goals and objectives for cultural resources. Cultural resource sites would be located and protected from project activities according to direction in FSM 2360 and 2430 (Coconino NF forest plan, page 50) and the requirements of 36 CFR 800 including 36 CFR 800.5 which provides direction for assessing adverse effects and proposing a finding of no adverse effect. Consultation with AZ SHPO would occur as required and regulation 36 CFR 800 would be followed and met.

Relationship to Management Prescriptions: The amendment would apply to all 23 management areas (MAs) as described in the Coconino National Forest plan (pages 46 to 206-113) and in chapter 1 of the DEIS. The amendment would not affect the management of the MAs. All cultural resources are currently managed to minimize impacts and to achieve a “no effect” or “no adverse effect” determination whenever possible, in consultation with AZ SHPO, the council, and other consulting parties.

Relationship to Outputs: Outputs identified in the forest plan are associated with MMBF of sawtimber sales and products (meet demand for timber while reducing conflict with other resources), MMBF of firewood sold and free use (provide access to firewood), grazing capacity

(MAUM), and permitted livestock use (MAUM).The amendment would not affect outputs or change the long-term relationship between levels of goods (timber, firewood) and services.

The amendment would not affect outputs or change the long-term relationship between levels of goods (timber, firewood) and services. All cultural resources are managed to minimize impacts and to achieve a “no effect” or “no adverse effect” determination whenever possible, in consultation with AZ SHPO, the council, and other consulting parties regardless of forest plan desired outputs.

Alternative C – Kaibab National Forest Site-Specific Nonsignificant Forest Plan Amendments

Three site-specific, nonsignificant forest plan amendments are proposed for alternative C. The potential impacts of two related planning efforts was evaluated.

A revised MSO recovery plan, issued by the FWS was finalized in December of 2012 (USDI 2012). At some point in time, the Kaibab NF may amend its current forest plan to be consistent with this recovery plan. For this analysis, a forest plan amendment would be needed to utilize the 2012 recovery plan direction as it differs from what is currently included in the Kaibab NF forest plan.

Currently, the Kaibab NF is revising its forest plan (USDA 2012). A revised forest plan may affect the need for amendments 1 through 3 in the following ways:

> **Amendment 1**: The current Kaibab NF forest plan has canopy cover requirements in VSS 4 to VSS 6, has requirements for managing goshawk habitat for a balance of VSS,, and requirements for managing reserve trees in management created openings (greater than 1 acre in ponderosa pine in goshawk foraging areas and PFAs) is presented differently in the draft forest plan, as currently written (USDA 2012, page 14 to page 18). Amendment 1 would be in alignment with the draft forest plan (as currently written) as it: (1) provides for managing crowns of trees within the mid-aged to old groups as interlocking or nearly interlocking (USDA 2012 page 15); (2) manages forest conditions in some areas (e.g., goshawk PFAs, MSO protected areas, drainages, and steep north-facing slopes) with 10 to 20 percent higher basal area in mid-aged to old tree groups (USDA 2012, Page 16); and (3) manages for known and replacement nest areas (USDA 2012, page 45).
>
> The draft forest plans allow for project specific plan amendments. The portion of the amendment that allows deviation from maintaining three to five reserve trees per acre and having openings up to 90 percent for lands managed for an open reference condition would be consistent with what is allowed at the project level. The desired condition in ponderosa pine at the landscape scale is a ponderosa pine forest vegetation community with a mosaic of forest conditions composed of structural stages ranging from young to old trees. The forest is generally uneven-aged and open. Groups of old trees are mixed with groups of younger trees. Occasional areas of even-aged structure are present. Denser tree conditions exist in some locations such as north-facing slopes, canyons, and drainage bottoms (USDA 2012, page 16).
>
> The terms “interspaces,” “open reference condition,” and “stands” do not appear in the draft forest plan (as currently written). The amendment would provide additional site-specific

direction and definitions that apply to landscape restoration that are not precluded by the draft forest plan.

Amendment 2 would allow for mechanically treating and using prescribed fire in the proposed Garland Prairie RNA. The amendment would no longer be needed once the new forest plan is put in place. The formerly proposed RNA would be managed as a grassland management area (MA). The restoration project would be consistent with the desired conditions for this MA (as currently written).

Amendment 3: The amendment would be in alignment with the draft forest plan (as currently written) in that it defers management of MSOs to direction in the MSO recovery plan. The revised (2012) MSO recovery plan does not require a specific method for habitat monitoring, does not require treatments in increments, and the proposed basal area in nest/roost habitat is referenced in the 2012 revised plan. In the recovery plan, project monitoring is deferred to the management agency. For this project, monitoring and the final design of treatments (addressing incremental treatment) would be determined in consultation with the FWS.

Although restricted habitat is referred to as “recovery habitat” and “nest/roost habitats” in the 2012 revised plan (USDI 2012, pp. 3, 4), the project’s desired conditions for nesting and roosting habitat is consistent with the revised recovery plan. The revised plan still recommends that a percentage (10 to 25 percent) of recovery habitat be managed as nesting/roosting (USDI 2012, page VIII). Designating habitat in the project with the best potential would move toward desired percentages in recovery habitat. Amendment 3 would provide additional site-specific requirements at the project scale that would not be precluded by the revised forest plan or the new recovery plan (USDI 2012).

Amendment 1. Management of Canopy Cover and Ponderosa Pine With an Open Reference Condition Within Goshawk Habitat (Kaibab NF)

Amendment 1 is a specific, one-time variance for the Kaibab NF portion of the restoration project. Once the project is complete, current forest plan direction would apply to the project area. The language proposed does not apply to any other forest project. The amendments would be authorized per direction in the National Forest Management Act of 1976 (NFMA) and its implementing regulations found in 36 CFR 219 (1982).

Amendment Description

In the “Vegetation Management – Landscapes Outside Goshawk Post-fledgling Family Areas” and “Vegetation Management –Within Post-fledgling Family Areas” section of the forest plan, a nonsignificant plan amendment would: (1) add the desired percentage of interspace within uneven-aged stands to facilitate restoration, (2) add the interspace distance between tree groups, (3) add language clarifying where canopy cover is and is not measured, (4) allow 27,675 acres to be managed for an open reference condition (which affects canopy cover guidelines for VSS 4 through VSS 6 groups and reserve trees), and (5) add a definition to the forest plan glossary for the terms interspaces, open reference condition, and stands.

The Kaibab National Forest plan directs projects to manage for uneven-aged stand conditions within goshawk habitat. Forested groups consist of an interspersion of six vegetation structural stages (VSS 1 to VSS 6). For the purposes of this amendment, the following definitions apply:

- **Stands** are defined as a contiguous area of trees sufficiently uniform in forest type, composition, structure, and age class distribution, growing on a site of sufficiently uniform conditions to be a distinguishable unit. Four classification characteristics are generally used to distinguish forest stands: biophysical site (soils, aspect, elevation, plant community association, climate, etc.), species composition, structure (density, and age (1-aged, 2-aged, uneven-aged)), and management emphasis (administrative requirements and local management emphasis that will shape structure over time). Based upon agency guidelines, the minimum stand mapping size is 10 acres.
- **Interspaces** are defined as the open space between tree groups intended to be managed for grass/forb/shrub vegetation during the long term. Interspaces may include scattered single trees.
- **Open reference condition** is defined as forested ponderosa pine areas with mollic-integrade soils to be managed as a relatively open forest with trees typically aggregated in small groups within a grass/forb/shrub matrix.

Background

Canopy cover is defined as “the percentage of a fixed area covered by the crowns of plants delimited by a vertical projection of the outermost perimeter of the spread of foliage” (Reynolds et al. 1992). Obtaining consistent results has been difficult; even the definition of the term is dependent on the method of measurement. To resolve this issue, the Forest Service used the Forest Vegetation Simulation (FVS) crown width model as the basis for developing stocking densities that would achieve desired canopy cover levels.

The forest plan directs projects to measure “vertical crown projection on average across the landscape” (see Kaibab NF forest plan, page 29). Whereas the forest plan clearly provides direction for meeting minimum canopy cover percentages in VSS 4 to 6, the plans lack explicit language for measuring canopy cover. Although the forest plan provides direction and desired conditions for the vegetation structural stages, the forest plan does not describe the relationship between nonforested areas (interspace) and natural openings across the landscape.

Nonforested areas (interspaces) occur between individual trees, tree clumps, and tree groups. These nonforested areas (interspaces) are not equivalent to VSS 1. Whereas VSS 1 may provide openings in the short term, this structural stage is expected to regenerate tree cover in the long term. Refer to the silviculture report and the implementation plan (appendix D) which provides minimum stocking guidelines that have been developed to assure canopy cover requirements are met.

Approximately 198,136 acres (61 percent) of the forested areas (within the project area) have an open reference condition that corresponds to mollic-integrade soils. The desired condition is to have a portion of these acres (27,675 acres) managed as a relatively open forest with trees typically aggregated in small groups within a grass/forb/shrub matrix (Woolsey 1911, Cooper 1960, White 1985, Pearson 1950, Covington et a1. 1997, Abella and Denton 2009). See the soils specialist report for detailed information. Figure 65 displays the general locations of areas subject to canopy cover requirements in VSS 4 to VSS 6 on the Coconino and Kaibab NFs. Figure 66 displays the general locations that would be managed for an open reference condition and grassland restoration. Edited or added/new text is **bolded** in the "Proposed New Guideline Language" column in table 106.

Table 106. Alternative C amendment 1 – management of canopy cover and ponderosa pine with an open reference condition in goshawk habitat (Kaibab NF)

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
Landscapes Outside Goshawk Post-fledgling Family Areas	
No corresponding forest plan direction (see Kaibab NF forest plan, p. 29).	**General: Within ponderosa pine stands, manage over time for uneven-aged stand conditions composed of heterogeneous mosaics of tree groups and single trees, with interspaces between tree groups. The size of tree groups, as well as sizes and shapes of interspaces, should be variable. Over time, the spatial location of the tree groups and interspaces may shift within the uneven-aged stand.**
General: The distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir forests is 10% grass/forb/shrub (VSS 1), 10% seedling-sapling (VSS 2), 20% young forest (VSS 3), 20% mid-aged forest (VSS 4), 20% mature forest (VSS 5), 20% old forest (VSS 6). NOTE: The specified percentages are a guide and actual percentages are expected to vary + or – up to 3% (Kaibab NF forest plan, p. 29).	General: **For the areas managed for tree crown development**, the distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir forests is 10 percent grass/forb/shrub (VSS 1), 10 percent seedling-sapling (VSS 2), 20 percent young forest (VSS 3), 20 percent mid-aged forest (VSS 4), 20 percent mature forest (VSS 5), and 20 percent old forest (VSS 6). Note: the specified percentages are a guide and actual percentages are expected to vary plus or minus up to 3 percent.
The distribution of VSS, tree density, and tree age are a product of site quality in the ecosystem management area. Use site quality to guide in the distribution of VSS, tree density and tree ages. Use site quality to identify and manage dispersal PFA and nest habitat at 2 to 2.5 mile spacing across the landscape (Kaibab NF forest plan, p.29).	No Change
Snags are 18" or larger d.b.h. and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape (Kaibab NF forest plan, p. 29).	Snags are 18" or larger d.b.h. and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, **canopy cover as defined by vertical crown projection is evaluated within mid-aged to old forest vegetation structural stage groups (VSS 4, 5, and 6).**
No corresponding forest plan direction	**Develop and maintain a highly diverse vegetation mosaic: 30 to 90 percent of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns. Within areas managed for an open reference condition, 10 to 30 percent of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns.**

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
No corresponding forest plan direction	**Tree group spatial distribution may be highly variable based on local site and current conditions; the interspaces between groups may range from 20 to 200 feet, but generally between 25 and 100 feet apart from drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.**
No corresponding forest plan direction	**Each tree group is generally dominated by one vegetation structure stage. The spatial arrangement of trees, high dispersion of vegetation structural stage diversity, and interspaces comprise each uneven-aged forest stand. Collectively these stands aggregate to uneven-aged forest landscapes, similar to natural conditions.**
The order of preferred treatment for woody debris is: (1) prescribed burning, (2) lopping and scattering, (3) hand piling or machine grapple piling, (4) dozer piling (Kaibab NF forest plan, p. 29).	No Change
Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stages (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stages (VSS 1, VSS 2, and VSS 3) (Kaibab NF forest plan, p. 29).	Canopy Cover: Canopy cover guidelines apply only to mid-aged to old forest structural stage **groups** (VSS 4, VSS 5, and VSS 6) and not to grass/forb/shrub to young forest structural stage **groups** (VSS 1, VSS 2, and VSS 3) **or in interspaces, natural meadows, grasslands, or other areas not managed for forest cover.**
Spruce-Fir: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60% and 2/3 40%, mature forest (VSS 5) should average 60+%, and old forest (VSS 6) should average 60+%. Maximum opening size is 1 acre with a maximum width of 125 feet. Provide 2 groups of reserve trees per acre with 6 trees per group when opening size exceeds 0.5. Leave at least 3 snags, 5 downed logs, and 10–15 tons of woody debris per acre (Kaibab NF forest plan, p. 29).	No Change
Mixed Conifer: Canopy cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 40+%, mature forest (VSS 5) should average 50+%, and old forest (VSS 6) should average 60+%. Maximum opening size is up to 4 acres with a maximum width of up to 200 feet. Retain 1 group of reserve trees per acre of 3–5 trees per group for openings greater than 1 acre in size. Leave at least 3 snags, 5 downed logs, and 10–15 tons of woody debris per acre (Kaibab NF forest plan, pp. 29–30).	No Change

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5) should average 40+%, and old forest (VSS 6) should average 40+%. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, 3–5 trees per group, will be left if the opening is greater than an acre in size. Leave at least 2 snags per acre, 3 downed logs per acre, and 5–7 tons of woody debris per acre (Kaibab NF forest plan, p. 30).	Ponderosa Pine: Canopy cover for mid-aged forest (VSS 4) should average 40+ percent, mature forest (VSS 5) should average 40+ percent, and old forest (VSS 6) should average 40+ percent. Opening size is up to 4 acres with a maximum width of up to 200 feet. One group of reserve trees, three to five trees per group, will be left if the **created regeneration** opening is greater than an acre in size. Leave at least two snags per acre, three downed logs per acre, and 5 to 7 tons of woody debris per acre. **In acres managed for an open reference condition, canopy cover guidelines for VSS 4 through VSS 6 groups would not apply. One group of reserve trees, with a minimum of one to two trees per group will be left if the interspace size is greater than an acre in size. Interspace size is up to 4 acres. Leave at least two snags per acre, three downed logs per acre, and 5 to7 tons of woody debris per acre.**
Woodland: manage for uneven age conditions to sustain a mosaic of vegetation densities (overstory and understory), age classes, and species composition well distributed across the landscape. Provide for reserve trees, snags, and down woody debris (Kaibab NF forest plan, p. 30).	No Change
Vegetation Management – Within Post-fledgling Family Areas	
General: Provide for a healthy sustainable forest environment for the post-fledging family needs of goshawks. The principle difference between within the post-fledging family area and outside the post-fledging family area is the higher canopy cover within the post-fledging family area and smaller opening size within the post-fledging family area. Vegetative Structural Stage distribution and structural conditions are the same within and outside the post-fledging family area (Kaibab NF forest plan, p. 30).	No Change
No corresponding forest plan direction	**Canopy cover is evaluated at the group level within mid-aged to old forest structural stages groups (VSS 4, VSS 5, and VSS 6) and not within grass/forb/shrub to young forest structural stage groups (VSS 1, VSS 2, and VSS 3) or in interspaces, natural meadows and grasslands, or other areas not managed for forest conditions.**
Spruce-fir: Canopy Cover for mid-aged forest (VSS 4) should average 60+% and for mature (VSS 5) and old forest (VSS 6) should average 70+% (Kaibab NF forest plan, p. 30).	No Change
Mixed Conifer: Canopy Cover for mid-aged (VSS 4) to old forest (VSS 6) should average 60+% (Kaibab NF forest plan, p. 30).	No Change

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
Ponderosa Pine: Canopy Cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 50+%. Mature (VSS 5) and old forest (VSS 6) should average 50+% (Kaibab NF forest plan, p. 30).	No Change
Woodland: Maintain existing canopy cover levels (Kaibab NF forest plan, p. 30).	No Change
No corresponding forest plan direction	**Develop and maintain a highly diverse vegetation mosaic: 30 to 90 percent of the uneven-aged stand should be under ponderosa pine and deciduous tree crowns.**
No corresponding forest plan direction	**Tree group spatial distribution may be highly variable based on local site and current conditions; the interspaces between groups may range from 20 to 200 feet, but generally between 25 and 100 feet apart from drip line to adjacent drip line. This spacing of groups is not affected by single trees in the interspace.**
No corresponding forest plan direction	**Each tree group is generally dominated by one vegetation structure stage. The spatial arrangement of trees, high dispersion of vegetation structural stage diversity, and interspaces comprise each uneven-aged forest stand. Collectively these stands aggregate to uneven-aged forest landscapes, similar to natural conditions.**
Glossary	
No corresponding forest plan direction	**Interspaces: The open space between tree groups intended to be managed for grass/forb/shrub vegetation during the long term. Interspaces may include scattered single trees.**
No corresponding forest plan direction	**Stands: Contiguous area of trees sufficiently uniform in forest type, composition, structure, and age class distribution, growing on a site of sufficiently uniform conditions to be a distinguishable unit.**
No corresponding forest plan direction	**Open reference condition: Forested ponderosa pine areas with mollic-integrade soils to be managed as a relatively open forest with trees typically aggregated in small groups within a grass/forb/shrub matrix.**

Edited and new text is **bolded**.

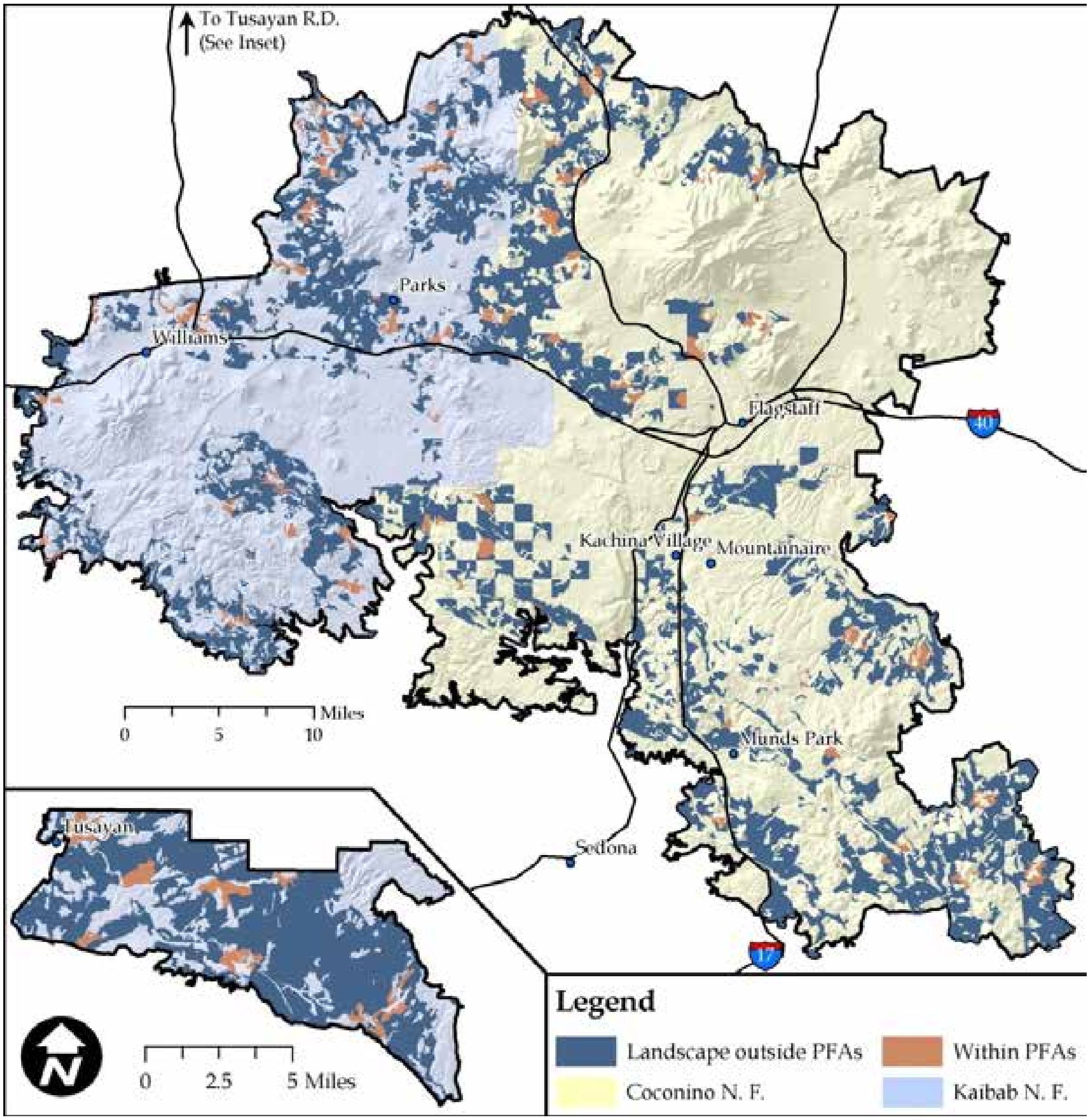

Figure 65. Alternative C general location of goshawk habitat subject to canopy cover requirements in VSS 4 to VSS 6 (Coconino NF and Kaibab NF)

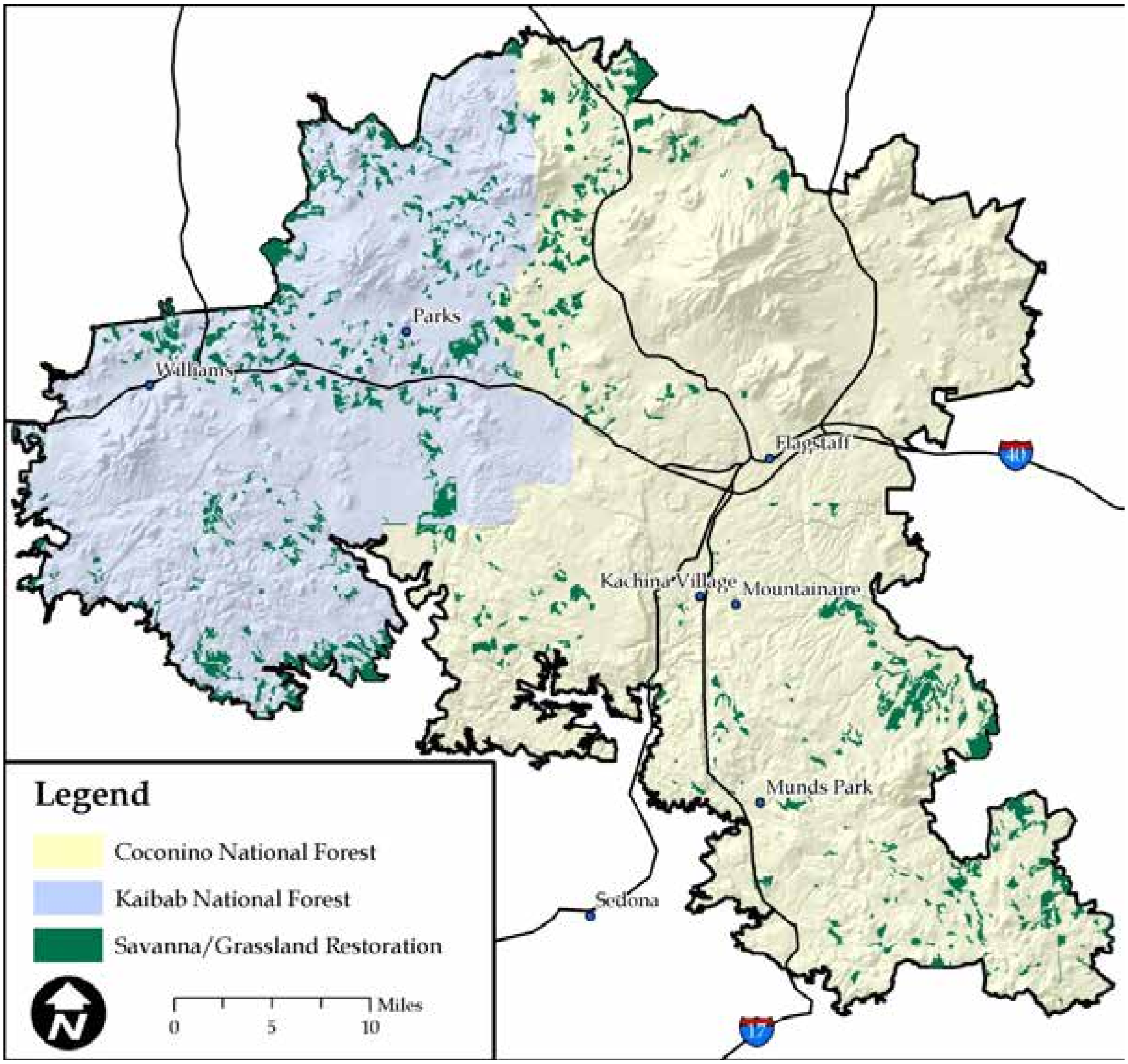

Figure 66. Alternative C general locations of savanna and grassland restoration treatments (Coconino NF and Kaibab NF)

Significance Evaluation

Per FSM 1926.51, changes to the land management plan that are not significant can result from:

1. Actions that do not significantly alter the multiple-use goals and objectives for long term land and resource management.
2. Adjustments of management area boundaries or management prescriptions resulting from further onsite analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long term land and resource management.
3. Minor changes in standards and guidelines.
4. Opportunities for additional projects or activities that will contribute to achievement of the management prescription.

Per FSM 1926.52, circumstances that may cause a significant change to a land management plan include:

1. Changes that would significantly alter the long-term relationship between levels of multiple-use goods and services originally projected (see section 219.10(e) of the planning regulations in effect before November 9, 2000 (see 36 CFR parts 200 to 299, revised as of July 1, 2000)), and
2. Changes that may have an important effect on the entire land management plan or affect land and resources throughout a large portion of the planning area during the planning period.

Analysis demonstrated that the proposed amendment is nonsignificant (FSM 1926.51) because the actions would not measurably alter the multiple-use goals and objectives for long term land and resource management. How actions could potentially affect timing, location and size, relationship to forest goals, objectives, outputs, and management prescriptions was evaluated.

Timing: The Kaibab National Forest forest plan has been in place (and amended) since 1988, and plan revision efforts are underway. While the amendment does provide clarification that has been lacking since the forest plan was implemented, it is specific to this project.

Location and Size: Suitable goshawk habitat on the Kaibab NF encompasses approximately 541,000 acres (Keckler 2011, personal communication) and the project area is comprised of about 399,633 acres of goshawk habitat. The amendment would affect approximately 20 percent of all suitable goshawk habitats on the forest and about 27 percent of goshawk habitat within the project area. For this reason, location and size was determined to be nonsignificant.

Relationship to Forest Goals and Objectives: Alternative C would meet goshawk forest plan canopy cover requirements in VSS 4 to 6 in all acres except the 27,675 acres managed for an open reference condition. In all acres but the open reference condition acres, actions would move toward the desired VSS size class distribution.

For this reason, the amendment is consistent with forest goals for wildlife and fish that promotes improving habitats through the development of habitat quality and diversity and the identification and protection of key habitats; and for improving habitats for listed threatened, endangered, or sensitive species of plants and animals and other species as they become threatened or endangered (Kaibab NF forest plan, page18).

Relationship to Management Prescriptions: Table 107 displays the acres associated with Kaibab NF geographic areas (GAs) and land use zones (LUZ).

Canopy Cover: The acres of forestwide GAs and LUZ affected by the canopy cover portion of the amendment (105,847 acres total) would range from less than 1 percent (LUZ 21) to 33 percent (GA 10). The amendment is specific to this project and would not impose requirements on the future management of canopy cover within these acres of goshawk habitat.

Open Reference Condition: The acres of forestwide GAs affected by the open reference condition portion of the amendment (27,675 acres total) would range from less than 1 percent (GA 1) to 9 percent (GA 2).The amendment is consistent with the management emphasis of providing for multiple uses that includes wildlife habitat and moving ponderosa pine toward desired forest structure, including northern goshawk habitats. The amendment is specific to this project and would not impose requirements on the future management of the 27,675 acres of goshawk non-PFA; however, forest plan revision decisions may.

Table 107. Alternative C amendment 1 geographic area acres (Kaibab NF)

GA	GA Description	Forestwide Acres	Proposed Amendment Acres	Forestwide Acres Affected (Percent)
Canopy Cover				
GA 2	Williams Forestland	308,394	72,614	24
GA 10	Tusayan Forestland	86,250	28,247	33
GA 3	North Williams Woodland	65,533	1,287	2
GA 1	Western Williams Woodland	169,041	1,970	1
GA 8	Tusayan Woodland	195,118	1,025	1
LUZ 21	Developed recreation sites	1,556	702	<1
Mapping Error	Camp Navajo	NA – Not in land management plan area	2	NA
Open Reference Condition				
GA 2	Williams Forestland	308,394	26,869	9
GA 3	North Williams Woodland	65,533	500	1
GA 1	Western Williams Woodland	169,041	302	<1
Mapping Error	Camp Navajo	NA – Not in land management plan area	4	<1

Relationship to Outputs: Outputs identified in the forest plan are associated with sawtimber and other product harvest levels (meet demand for timber while reducing conflict with other resources), commercial and personal use firewood programs (MBF), grazing capacity (AUM), watershed (acres in unsatisfactory condition and water yield), developed recreation (management of public sites at the standard service level), developed and dispersed recreation outputs (RVD), transportation (acres closed to off-road vehicle use), habitat diversity (change in habitat diversity index), old growth habitat (acres), and average annual wildlife and fish use (WFUD).

The canopy cover portion of the amendment provides clarification and disclosure of methods for meeting forest plan requirements. It has no relationship to outputs or to the relationship between the level of goods (timber, firewood) and services and would not result in a change in land productivity or timber suitability classification.

Managing a portion of the landscape for an open reference condition affects about 27,675 acres of an estimated 490,368 acres of suitable timber lands. The management strategy on these acres would result in an extended rotation period between treatments beyond what was considered in developing the long-term sustained yield output in the forest plan. In the short term (10-year period), the amendment affects about 6 percent of the suitable land base. Due to the minimal acres affected, the amendment would not measurably alter outputs in the foreseeable future on a forestwide basis or change the long-term relationship between levels of goods (timber, firewood) and services. There would be no change in land productivity; therefore, it would not affect timber suitability classification.

Whether the 27,675 acres would continue to be managed as suitable timber in the long term will be evaluated during the forest plan revision process. No portion of the amendment would affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use.

Amendment 2. Mechanical Treatment and Prescribed Fire in the Proposed Garland Prairie Research Natural Area (RNA) (Kaibab NF)

Amendment 2 is a specific, one-time variance for the Kaibab NF portion of the restoration project. Once the project is complete, current forest plan direction would apply to the project area. The language proposed does not apply to any other forest project. The amendments would be authorized per direction in the National Forest Management Act of 1976 (NFMA) and its implementing regulations found in 36 CFR 219 (1982).

Background

Management of the proposed Garland Prairie Research Natural Area (RNA) was addressed in the current forest plan but the designation (through an official establishment record) was never completed. When Garland Prairie was originally recommended as a RNA, there was a need for montane grassland type representation. This is no longer true and, as a result, it does not meet the criteria identified in Southwestern Region research natural area process. In the forest plan revision process, it is proposed to be managed as the “Garland Prairie Management Area.”

Currently, the proposed RNA is heavily encroached upon by small to mid-diameter ponderosa pine trees and infestations of Dalmation toadflax. Historically, grassland communities on the forest had less than 10 percent tree cover. Impacts from grazing, logging, and fire suppression practices reduced or eliminated the vegetation necessary to carry low intensity surface fires across the landscape, thereby altering the natural fire regimes and allowing uncharacteristic forest succession to take place. In addition to past practices, the location of the proposed RNA within the urban interface has hindered the ability to use fire as a natural process within the RNA (Kaibab NF 2012).

Amendment Description

The amendment would add language to allow prescribed fire and mechanical treatments in order to maintain and/or restore the ecological qualities of the proposed RNA. Figure 67 displays the proposed mechanical and prescribed fire treatments. Edited or added/new text is **bolded** in table 108.

Table 108. Alternative C amendment 2 Kaibab NF proposed Garland Prairie Research Natural Area (RNA)

Current Kaibab NF Forest Plan Direction	Proposed New Guideline Language*
No corresponding plan direction (see Kaibab NF forest plan, pp.95–96).	**Vegetation Management Planning and Analysis** **Utilize mechanical treatment and prescribed burning to reestablish the role of fire as a natural process when needed to maintain or restore the high elevation grassland ecotone habitat dominated by Arizona fescue and mountain muhly, to maintain genetic diversity, and move toward historic reference condition. Do not construct fire line.**

* Edited text is **bolded.**

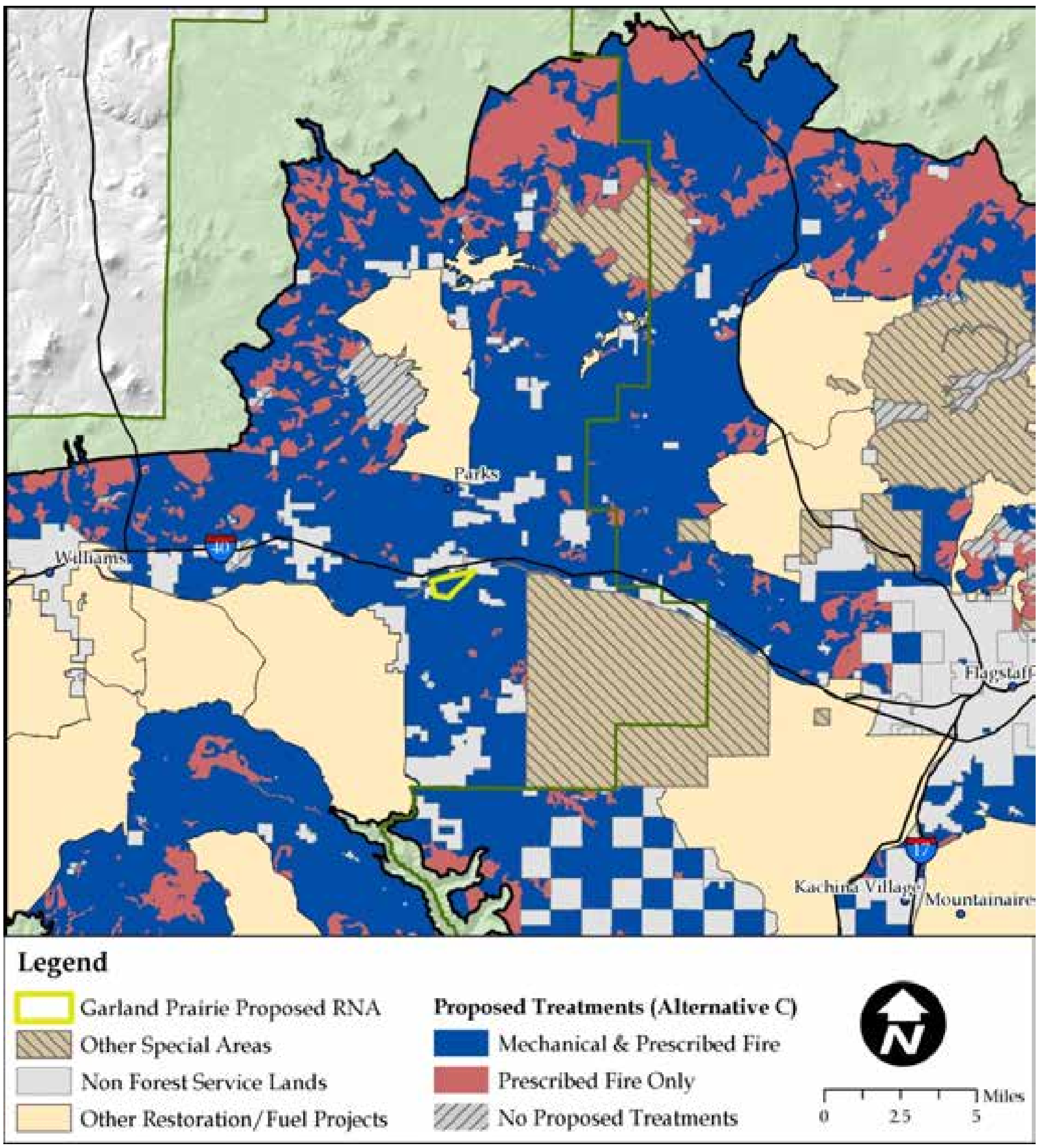

Figure 67. Alternative C treatments in the Garland Prairie proposed RNA (Kaibab NF)

Significance Evaluation

Per FSM 1926.51, changes to the land management plan that are not significant can result from:

1. Actions that do not significantly alter the multiple-use goals and objectives for long term land and resource management.
2. Adjustments of management area boundaries or management prescriptions resulting from further onsite analysis when the adjustments do not cause significant changes in the multiple-use goals and objectives for long term land and resource management.
3. Minor changes in standards and guidelines.
4. Opportunities for additional projects or activities that will contribute to achievement of the management prescription.

Per FSM 1926.52, circumstances that may cause a significant change to a land management plan include:

1. Changes that would significantly alter the long-term relationship between levels of multiple-use goods and services originally projected (see section 219.10(e) of the planning regulations in effect before November 9, 2000 (see 36 CFR parts 200 to 299, revised as of July 1, 2000)), and
2. Changes that may have an important effect on the entire land management plan or affect land and resources throughout a large portion of the planning area during the planning period.

Analysis demonstrated that the proposed amendment is nonsignificant (FSM 1926.51) because the actions would not measurably alter the multiple-use goals and objectives for long term land and resource management and actions. How actions could potentially affect timing, location and size, relationship to forest goals, objectives, outputs, and management prescriptions was evaluated.

Timing: The Kaibab NF forest plan has been in place (and amended) since 1988, and plan revision efforts are underway.

Location and Size: The amendment would affect 100 percent of the 300-acre proposed RNA (Special Area 7) and acres adjacent to the area. In the context of the forest, it would have no effect on other special areas that have been designated because of their unique or special characteristics including other RNAs, wilderness, botanical areas, and national recreation trails. While the amendment would affect 100 percent of the proposed Garland Prairie RNA, in the context of all forest special areas, location and size was determined to be nonsignificant. In the draft forest plan (as currently written in 2012), the area would no longer be proposed as a RNA. It would be managed as a grassland management area.

Relationship to Forest Goals and Objectives: The amendment is consistent with Forest Service policy (FSM 4063.02) by maintaining and/or restoring the ecological values associated with the proposed RNA.

Relationship to Outputs: The proposed amendment would affect approximately 100 percent of Special Area 7. The RNA is managed as high elevation grassland and is not part of the suitable land base (timber, grazing, recreation, minerals, and energy resource activities). Therefore, the amendment would not alter outputs or change the long-term relationship between levels of goods (timber, commercial and personal use firewood) and services. No grazing capacity exists for the proposed RNA and livestock grazing has been excluded since 1989 (Kaibab NF 2012). Therefore, the amendment would not affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use and would not impose requirements on future management of the RNA.

Amendment 3 – MSO Habitat Management (Kaibab NF)

Amendment 3 is a specific, one-time variance for the Kaibab NF portion of the restoration project. Once the project is complete, current forest plan direction would apply to the project area. The language proposed does not apply to any other forest project. The amendment would be authorized per direction in the National Forest Management Act of 1976 (NFMA) and its implementing regulations found in 36 CFR 219 (1982).

Amendment Description

The amendment, which is specific to restricted habitat in pine-oak, would allow for designating less than 10 percent of restricted habitat on the Kaibab NF as target or threshold (i.e., future nesting and roosting habitat) based on the quality of the habitat. Definitions of target and threshold habitat would be added since the current forest plan refers to “threshold” in terms of values and desired conditions (see Kaibab NF forest plan, page 25) within restricted habitat and there is no reference to “target” conditions. In restricted pine-oak habitat, the amendment would allow 2,090 acres of restricted habitat to be managed for a minimum range of 110 to 150 basal area.

The amendment would remove language that limits PAC treatments in the recovery unit to 10 percent increments and language that requires the selection of an equal number of untreated PACs as controls. The amendment would remove language referencing monitoring (pre- and post-treatment, population, and habitat). Replacement language would defer final project design and monitoring to the FWS’ biological opinion specific to MSO for the project.

Background

Incremental Treatments and Monitoring Responses to MSO Treatments

Monitoring assesses the effectiveness of management actions and provides the adaptive framework for more successful management guidelines. Monitoring habitat allows for the modeling future forest conditions to determine if there will be adequate habitat to support MSO populations. Monitoring and final project design (addressing incremental treatments) for all proposed activities in all MSO habitat would be developed in consultation with the FWS in a manner specific to this project.

Manage for Less than 10 Percent Restricted Habitat on the Kaibab NF

Overall, about 11.5 percent (8,713 acres) of the 4FRI restricted habitat would be managed as current or future threshold habitat. On the Coconino NF portion of the project, where the most owls and the most MSO habitat occurs, 13 percent (6,465 acres) of the restricted layer would be designated as threshold habitat. The Kaibab NF portion of the 4FRI treatment area would have 8 percent (2,247 acres) of the restricted layer designated as threshold habitat. By creating more future nesting and roosting habitat on the Coconino NF, future MSO habitat would be more contiguous, better connected for dispersing MSOs, and occur in areas supporting higher densities of MSOs than if 10 percent of the restricted layer was designated by individual administrative boundaries.

Manage 2,090 Acres of MSO Restricted Target or Threshold Habitat for a Minimum of 110 to 150 Basal Area

The development of 2,090 acres of restricted target and threshold habitats would be managed toward meeting a 110 to 150 basal area for MSO nest and roost habitat as recommended in the revised MSO recovery plan (USDI 2012). It would allow more of the uncharacteristic in-growth of mid-aged and mid-sized trees that currently dominate the 4FRI landscape to be removed while retaining nesting and roosting habitat components. Thinning more of these trees would improve forest health, increasing the ability to retain large trees, and increase large tree growth rates as described in the revised recovery plan. This would increase forest spatial heterogeneity, improve tree age diversity, and benefit prey habitat. Increasing the basal area range would provide opportunities to mimic canopy gap processes which produce horizontal variation in stand structure. These changes would both increase and retain nesting and roosting structure and increase understory cover. Research suggests that small mammal biomass (including voles and mice) drives spotted owl reproductive output, and thinning smaller trees would improve subcanopy flight zone, thereby increasing MSO foraging effectiveness.

Edited or added/new text is **bolded** in table 109.

Table 109. Alternative C amendment 3 current and proposed forest plan language

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
MSO Standards	
No corresponding direction currently exists	**The project will comply with the biological opinion that has been developed in consultation with the FWS.**
Provide three levels of habitat management -protected, restricted, and other forest and woodland types to achieve a diversity of habitat conditions across the landscape (Kaibab NF forest plan, page 22).	No Change
Protected areas include delineated protected activity centers; mixed conifer and pine-oak forests with slopes greater than 40% where timber harvest has not occurred in the last 20 years; and reserved lands which include wilderness, research natural areas, wild and scenic rivers, and congressionally recognized wilderness study areas (Kaibab NF forest plan, page 22).	No Change
Restricted areas include all mixed-conifer, pineoak, and riparian forests outside of protected areas (Kaibab NF forest plan, page 22).	No Change

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Other forest and woodland types include all ponderosa pine, spruce-fir, woodland, and aspen forests outside protected and restricted areas (Kaibab NF forest plan, page 22).	No Change
Survey all potential spotted owl areas including protected, restricted, and other forest and woodland types within an analysis area plus the area 1/2 mile beyond the perimeter of the proposed treatment area (Kaibab NF forest plan, page 23).	No Change
Establish a protected activity center at all Mexican spotted owl sites located during surveys and all management territories established since 1989 (Kaibab NF forest plan, page 23).	No Change
Allow no timber harvest except for firewood and fire risk abatement in established protected activity centers. For protected activity centers destroyed by fire, windstorm, or other natural disaster, salvage timber harvest or declassification may be allowed after evaluation on a case-by-case basis in consultation with US Fish and Wildlife Service (Kaibab NF forest plan, page 23).	No Change
Allow no timber harvest except for fire risk abatement in mixed conifer and pine-oak forests on slopes greater than 40% where timber harvest has not occurred in the last 20 years (Kaibab NF forest plan, page 23).	No Change
Limit human activity in protected activity centers during the breeding season (Kaibab NF forest plan, page 23).	No Change
In protected and restricted areas, when activities conducted in conformance with these standards and guidelines may adversely affect other threatened, endangered, or sensitive species or may conflict with other established recovery plans or conservation agreements; consult with US Fish and Wildlife Service to resolve the conflict (Kaibab NF forest plan, page 23).	No Change
Monitor changes in owl populations and habitat needed for de-listing (Kaibab NF forest plan, page 23).	**Deleted**
Guidelines– A. General – No Change	
Guidelines – B. Protected Areas, Protected Activity Centers	
Delineate an area of not less than 600 acres around the activity center using boundaries of known habitat polygons and/or topographic features. Written justification for boundary delineation should be provided (Kaibab NF forest plan, page 23).	No Change
The protected activity center boundary should enclose the best possible owl habitat configured in as compact a unit as possible, with the nest or activity center located near the center (Kaibab NF forest plan, page 23).	No Change

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
The activity center is defined as the nest site. In the absence of a known nest, the activity center should be defined as a roost grove commonly used during breeding. In the absence of a known nest or roost, the activity center should be defined as the best nest/roost habitat. (Kaibab NF forest plan, page 23)	No Change
Protected activity center boundaries should not overlap (Kaibab NF forest plan, page 23).	No Change
Submit protected activity center maps and descriptions to the recovery unit working group for comment as soon as possible after completion of survey (Kaibab NF forest plan, page 23).	No Change
Road or trail building in protected activity centers should be avoided but maybe permitted on a case-by-case basis for pressing management reasons (Kaibab NF forest plan, page 23).	No Change
Generally allow continuation of the level of recreation activities that was occurring prior to listing (Kaibab NF forest plan, page 23).	No Change
Require bird guides to apply for and obtain a special use permit. A condition of the permit shall be that they obtain a subpermit under the U.S. Fish and Wildlife Service Master Endangered Species permit. The permit should stipulate the sites, dates, number of visits and maximum group size permissible (Kaibab NF forest plan, pages 23 to 24).	No Change
Harvest firewood when it can be done in such a way that effects on the owl are minimized. Manage within the following limitations to minimize effects on the owl (Kaibab NF forest plan, page 24).	No Change
Retain key forest species such as oak (Kaibab NF forest plan, page 24).	No Change
Retain key habitat components such as snags and large downed logs (Kaibab NF forest plan, page 24).	No Change
Harvest conifers less than 9 inches in diameter only within those protected activity centers treated to abate fire risk as described below (Kaibab NF forest plan, page 24).	No Change
Treat fuel accumulations to abate fire risk (Kaibab NF forest plan, page 24).	No Change
Select for treatment 10% of the protected activity centers where nest sites are known in each recovery unit having high fire risk conditions. Also select another 10% of the protected activity centers where nest sites are known as a paired sample to serve as control areas (Kaibab NF forest plan, page 24).	**Deleted**

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Designate a 100 acre “no treatment” area around the known nest site of each selected protected activity center. Habitat in the no treatment area should be as similar as possible in structure and composition as that found in the activity center (Kaibab NF forest plan, page 24).	No Change
Retain woody debris larger than 12 inches in diameter, snags, clumps of broad-leafed woody vegetation, and hardwood trees larger than 10 inches in diameter at the root collar (Kaibab NF forest plan, page 24).	No Change
Select and treat additional protected activity centers in 10% increments if monitoring of the initial sample shows there were no negative impacts or there were negative impacts which can be mitigated by modifying treatment methods (Kaibab NF forest plan, page 24).	**Deleted**
Treat fuel accumulations to abate fire risk: Use combinations of thinning trees less than 9 inches in diameter, mechanical fuel treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100 acre "no treatment" area (Kaibab NF forest plan, p. 24).	No Change
Treat fuel accumulations to abate fire risk. Select for treatment 10% of the protected activity centers where nest sites are known in each recovery unit having high fire risk conditions. Also select another 10% of the protected activity centers where nest sites are known as a paired sample to serve as control areas (Kaibab NF forest plan, page 24).	Treat fuel accumulations to abate fire risk.
Use light prescribed fire in non-selected protected activity centers on a case-by-case basis. Burning should avoid a 100-acre “no treatment” area around the activity center. Large woody debris, snags, clumps of broad-leafed woody vegetation should be retained and hardwood trees larger than 10 inches diameter at the root collar (Kaibab NF forest plan, page 24).	No Change
Pre- and post-treatment monitoring should be conducted in all protected activity centers treated for fire risk abatement (See monitoring guidelines) (Kaibab NF forest plan, page 24).	**Deleted**
Steep Slopes (Mixed conifer and pine-oak forests outside protected activity centers with slopes greater than 40% that have not been logged within the past 20 years)	
No seasonal restrictions apply. Treat fuel accumulations to abate fire risk (Kaibab NF forest plan, page 24).	No Change
Use combinations of thinning trees less than 9 inches in diameter, mechanical fuel removal, and prescribed fire (Kaibab NF forest plan, page 24).	No Change
Retain woody debris larger than 12 inches in diameter, snags, clumps of broad-leafed woody vegetation, and hardwood tress larger than 10 inches in diameter at the root collar (Kaibab NF forest plan, page 24).	No Change

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Pre and post treatment monitoring should occur within all steep slopes treated for fire risk abatement (See monitoring guidelines) (Kaibab NF forest plan, page 24).	**Deleted**
Reserved Lands (Wilderness, Research Natural Areas, Wild and Scenic Rivers, and Congressionally Recognized Wilderness Study Areas	
Allow fire use where appropriate (Kaibab NF forest plan, page 25).	No Change
C. Restricted Areas (Mixed Conifer, Pine-Oak, and Riparian Forests)	
Mixed Conifer and Pine-oak Forests (See glossary definition)	
No corresponding direction	**Target habitat is a category of restricted habitat intended to provide future nesting and roosting habitat (see glossary definition for restricted habitat). The minimum values identified for the forest attributes represent the threshold for meeting nesting and roosting conditions (see the definition for threshold habitat). They can also be targets to be achieved with time and management. If less than 10 percent of the restricted habitat in ponderosa pine-Gambel oak qualifies as threshold habitat, the areas that can eventually achieve all threshold conditions simultaneously should be identified as target habitat and managed to achieve threshold conditions as rapidly as possible. Because no known nests or roosts occur in restricted habitat, target habitat is considered future nesting and roosting habitat.**
No corresponding direction	**Threshold habitat is a category of restricted habitat intended to provide for future nesting and roosting habitat (see definition for restricted habitat). A variety of forest structural attributes are used to define when nesting and roosting habitat is achieved (summarized in table III.B.1 of the 1995 recovery plan and table C-2 of the 2012 recovery plan). These values are targets that can be achieved with time and management (see definition for target habitat). When the minimum values identified for the forest attributes are met simultaneously, they represent the *threshold* of nesting and roosting conditions. Ten percent of restricted habitat in ponderosa pine-Gambel oak should be designated as threshold habitat. Management in threshold habitat cannot lower any of the forest attribute values below the nesting and roosting threshold unless a landscape analysis demonstrates an abundance of this habitat.**

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
	Because no known nests or roosts occur in restricted habitat, target habitat is managed as future nesting and roosting habitat.
Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species (Kaibab NF forest plan, page 25).	No Change
The following table displays the minimum percentage of restricted area which should be managed to have nest/roost characteristics. The minimum mixed conifer restricted area includes 10% at 170 basal area and an additional 15% of area at 150 basal area. The variables are for stand averages, are minimum threshold values and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum threshold values should be reduced below the threshold values unless a district-wide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting the threshold values. Management should be designed to create minimum threshold conditions on project areas where there is a deficit of stands simultaneously meeting minimum threshold conditions unless the district-wide or larger landscape analysis shows there is a surplus (Kaibab NF forest plan, page 25).	**Table 13** displays the minimum percentage of restricted area which should be managed to have nest/roost characteristics. The minimum mixed conifer restricted area includes 10 percent at 170 basal area and an additional 15 percent of area at 150 basal area. **In pine-oak, the minimum restricted area includes up to 10 percent at 170 BA and 15 percent of area at 110 to 150 basal area.** The variables are for stand averages, are minimum **target and** threshold **habitat** values, and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum **target and** threshold **habitat** values should be reduced below the **target and** threshold values unless a districtwide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting the threshold values. Management should be designed to create minimum **target and** threshold **habitat** conditions on project areas where there is a deficit of stands simultaneously meeting minimum **target and** threshold **habitat** conditions unless the districtwide or larger landscape analysis shows there is a surplus.

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*

Minimum Percentage of Restricted Areas Managed for Nest/Roost Characteristics

Variable	Mixed Conifer All RU	Mixed Conifer Other RU*	Pine-Oak Target and Threshold Habitat**
Restricted Area Percent	10%	+15%	**Up to** 10%
Stand Averages for:			
Basal Area	170	150	**110–150**
18 inch+ trees/ac	20	20	20
Oak Basal Area	NA	NA	20
Percent total existing:			
12–18”	10	10	15
18–24”	10	10	15
24+”	10	10	15

*__Mixed Conifer Other RU__ applies to the Kaibab NF.

**__Pine-Oak Target and Threshold Habitat__ applies to the Williams RD, Kaibab NF.

Attempt to mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes, into management prescriptions (Kaibab NF forest plan, page 25).	No Change
Maintain all species of native trees in the landscape including early seral species (Kaibab NF forest plan, page 25).	No Change
Allow natural canopy gap processes to occur, thus producing horizontal variation in stand structure (Kaibab NF forest plan, page 25).	No Change
Extend rotation ages for even-aged stands to greater than 200 years. Silvicultural prescriptions should explicitly state when vegetative manipulation will cease until rotation age is reached (Kaibab NF forest plan, page 25).	No Change
Save all trees greater than 24 inches d.b.h. In pine-oak forests, retain existing large oaks and promote growth of additional large oaks (Kaibab NF forest plan, page 25).	No Change
Encourage prescribed and wildland fire use to reduce hazardous fuel accumulation. Thinning from below may be desirable or necessary before burning to reduce ladder fuels and the risk of crown fire (Kaibab NF forest plan, page 25).	No Change
Retain substantive amounts of key habitat components: Snags 18 inches in diameter and larger down logs over 12 inches midpoint diameter hardwoods for retention, recruitment, and replacement of large hardwoods (Kaibab NF forest plan, page 25).	No Change

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Riparian Areas – No Change	
Domestic Livestock Grazing – No Change	
Old Growth – No Change	
D. Other Forest and Woodland Types – No Change	
E. Specific Recovery Units on the Kaibab NF – No Change	
F. Monitoring Guidelines	
Monitoring and evaluation should be collaboratively planned and coordinated with involvement from each national forest, USFWS Ecological Services Field Office, USFWS Regional Office, USFS Regional Office, Rocky Mountain Research Station, recovery team, and recovery unit working groups (Kaibab NF forest plan, page 26).	**See "Standards" for monitoring direction**
Population monitoring should be a collaborative effort with participation of all appropriate resource agencies (Kaibab NF forest plan, page 26).	**Deleted**
Habitat monitoring of gross habitat changes should be a collaborative effort of all appropriate resource agencies (Kaibab NF forest plan, page 26).	**Deleted**
Habitat monitoring of treatment effects (pre- and post-treatment) should be done by the agency conducting the treatment (Kaibab NF forest plan, page 27).	**Deleted**
Range-wide: Track gross changes in acres of owl habitat resulting from natural and human caused disturbances. Acreage changes in vegetation composition, structure, and density should be tracked, evaluated, and reported. Remote sensing techniques should provide an adequate level of accuracy (Kaibab NF forest plan, page 27).	**Deleted**
In protected and restricted areas where silvicultural or fire abatement treatments are planned, monitor treated stands pre- and post-treatment to determine changes and trajectories in fuel levels; snag basal areas; live tree basal areas; volume of down logs over 12 inches in diameter; and basal area of hardwood trees over 10 inches in diameter at the root crown (Kaibab NF forest plan, page 27).	**Deleted**
Upper Gila Mountain, Basin and Range East, and Basin and Range West Recovery Units: Assist the recovery team and recovery unit working groups to establish sampling units consisting of 19 to 39 square mile quadrats randomly allocated to habitat strata. Quadrats should be defined based on ecological boundaries such as ridge lines and watersheds. Quadrat boundaries should not traverse owl territories (Kaibab NF forest plan, page 27).	**Deleted**

Current Kaibab NF Forest Plan Direction	Proposed New Standard or Guideline Language*
Twenty percent of the quadrats will be replaced each year at random. Using the sample quadrats, monitor the number of territorial individuals and pairs per quadrat; reproduction; apparent survival; recruitment; and age structure. Track population density both per quadrat and habitat stratum (Kaibab NF forest plan, page 27).	**Deleted**

* Edited text is **bolded.**

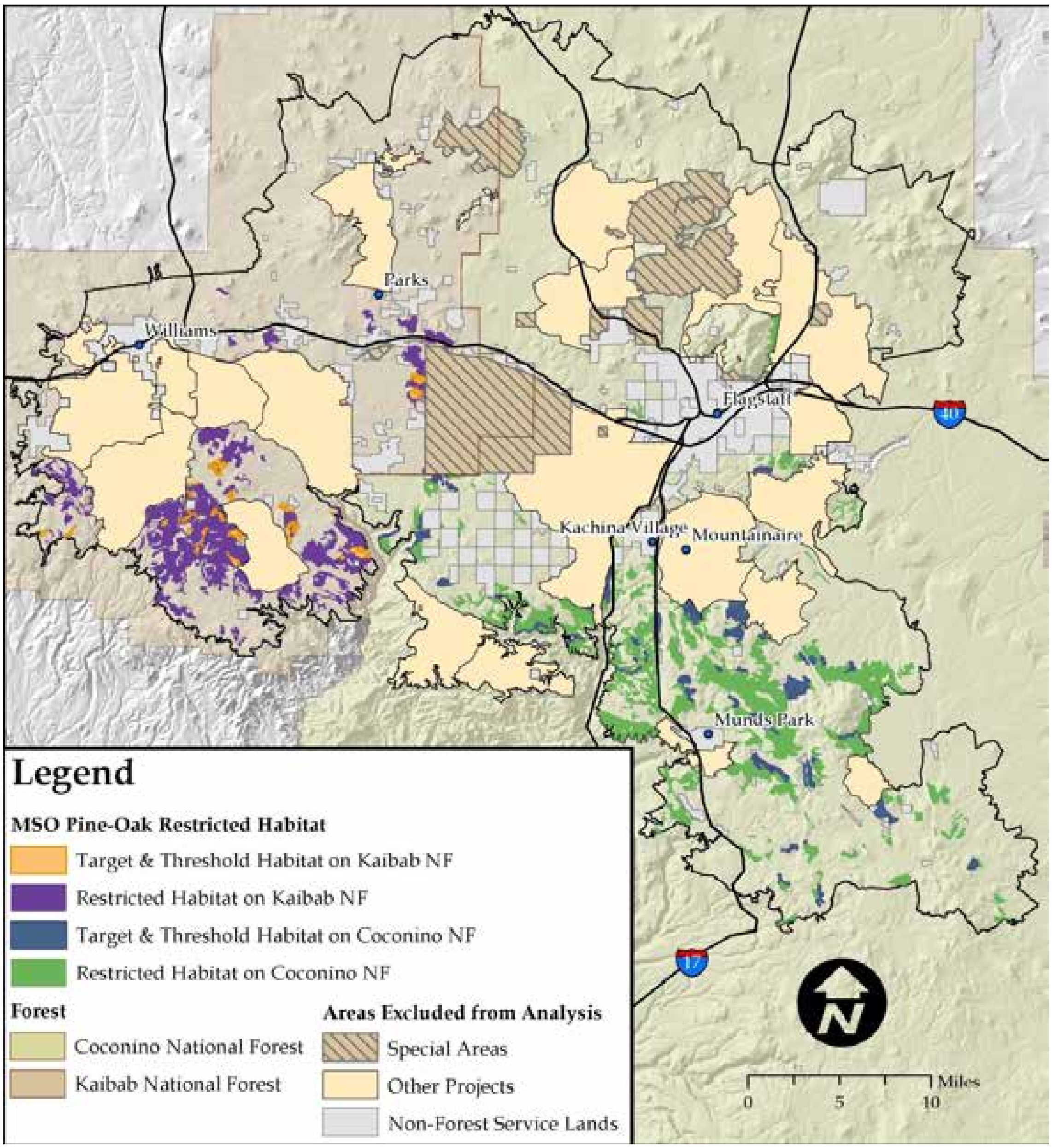

Figure 68. Alternative C amendment 3 landscape target and threshold analysis (Coconino NF and Kaibab NF)

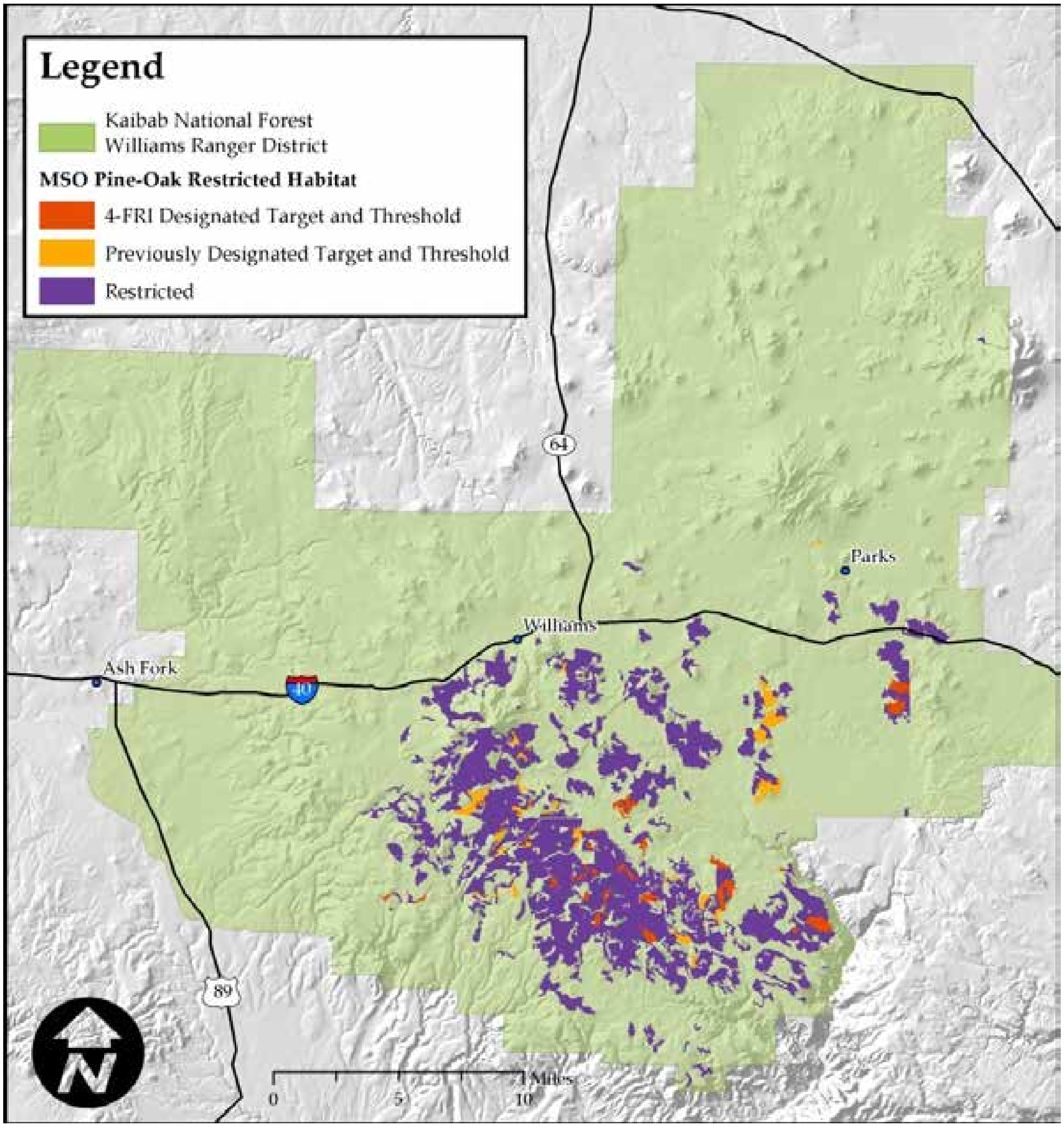

Figure 69. General locations of MSO threshold habitat on the Kaibab NF

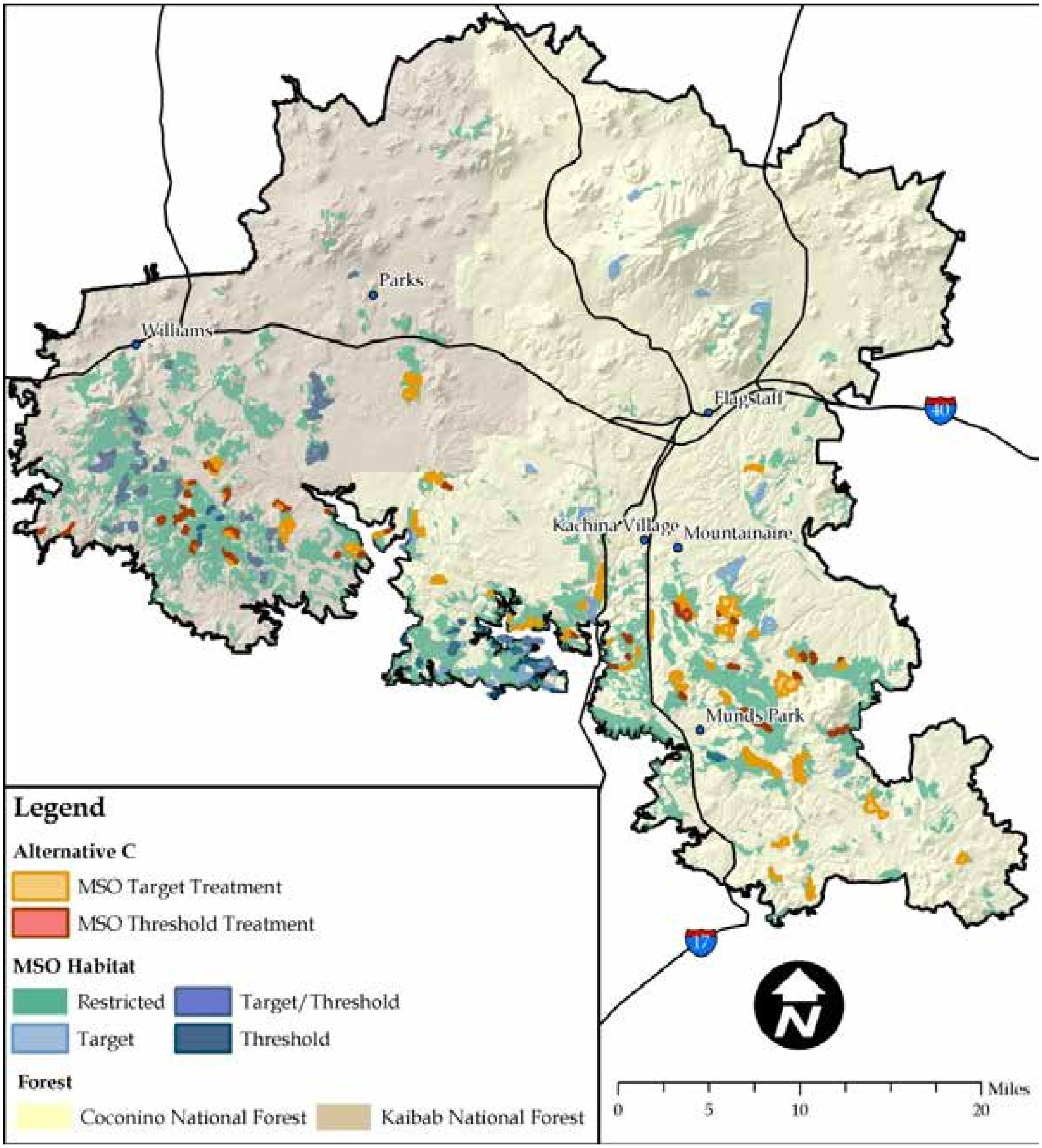

Figure 70. General location of MSO target and threshold habitat treatments within the project area (Coconino NF and Kaibab NF)

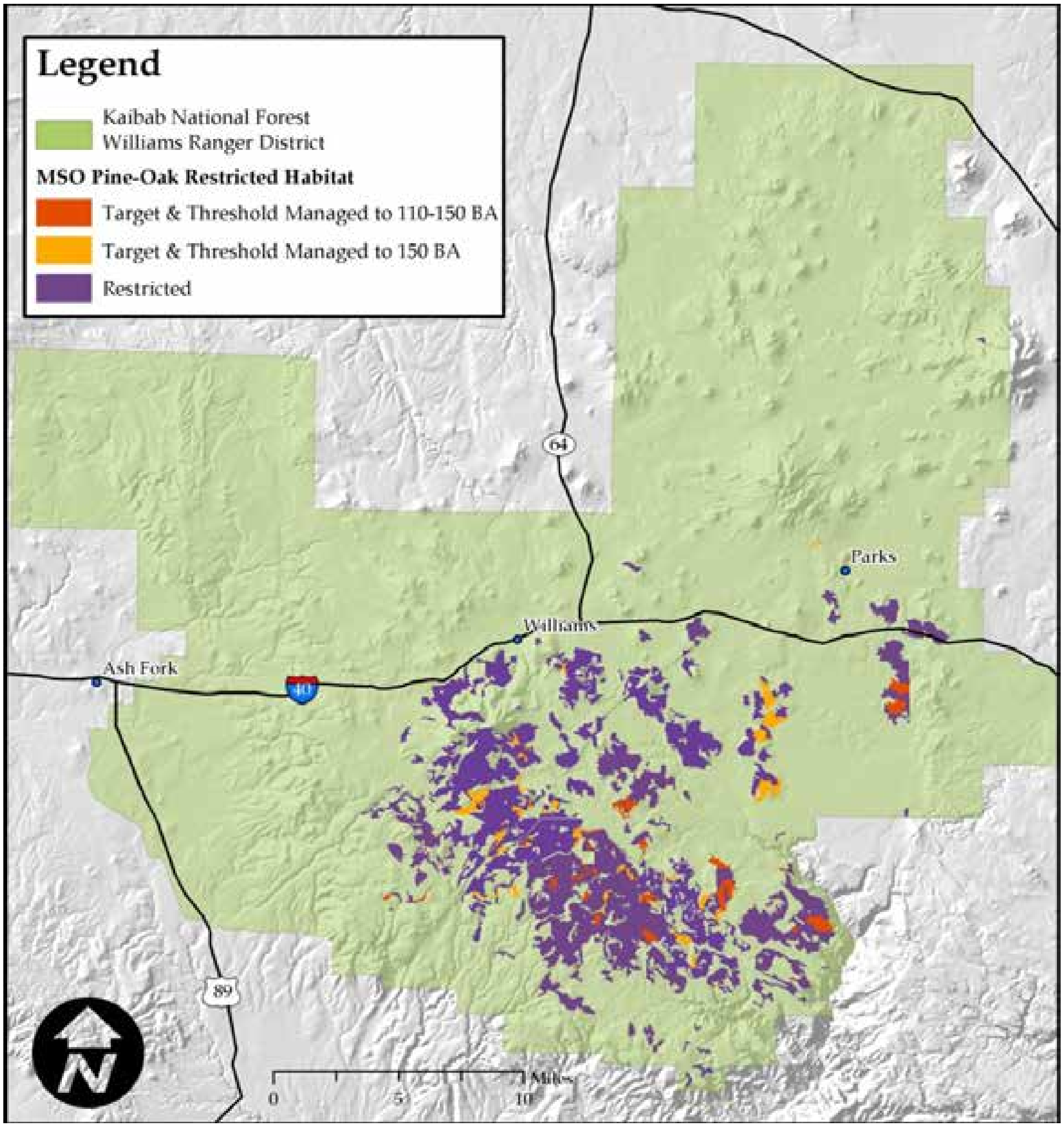

Figure 71. Alternative C amendment 1 general locations of MSO target and threshold habitat managed from 110 to 150 basal area (Kaibab NF)

Significance Evaluation

Timing: In terms of timing, the forest plan has been in place and amended several times since 1988, and revision efforts are underway. The forest plan incorporated direction (via an amendment) from the Forest Service Southwestern Region's 1996 "Amendment of Forest Plans Record of Decision" (USDA 1996). The actions allowed via the amendment are consistent with existing forest plan direction in that it designates future nesting and rooting habitat areas that at least minimally support target/threshold conditions or have the site potential to reach target conditions and whose current conditions most closely approaches target/threshold conditions.

Location and Size: There are 26,818 acres of MSO restricted habitat occurring entirely on the Kaibab NF. The amendment would affect the percentage of restricted acres designated as threshold habitat (8 percent), resulting in 2,247 acres on the Kaibab NF. About 11.5 percent of the designated restricted habitat would be managed for future nesting/roosting habitat across the 4FRI treatment area. Approximately 2,090 acres of restricted target and threshold habitats would be managed toward meeting a 110 to 150 BA for MSO nest and roost habitat. Monitoring in all MSO habitat would be in compliance with the FWS biological opinion for the project.

Relationship to Forest Goals and Objectives: Changing the minimal target/threshold acres in restricted habitat (2,247 acres) would not change the overall direction to manage for future nesting/roosting habitat on 10 percent of restricted acres across the planning area landscape as described in the forest plan. About 8,713 acres (about 11½ percent) are classified as target and threshold habitat in the 4FRI treatment area on both the Kaibab and Coconino NFs.

The development of 2,090 acres of restricted target and threshold habitats would be managed toward meeting a 110 to 150 BA for MSO nest and roost habitat as recommended in the MSO recovery plan (USDI 2012). This equates to affecting 8 percent of all MSO habitat on the Kaibab NF. Thinning more of these trees would improve forest health and increase the ability to retain large trees and increase large tree growth rates as described in the 2012 recovery plan. This would increase forest spatial heterogeneity, improve tree age diversity, and benefit prey habitat. Increasing the BA range would provide opportunities to mimic canopy gap processes which produce horizontal variation in stand structure. These changes would both increase and retain nesting and roosting structure and increase understory cover. Research suggests that small mammal biomass (including voles and mice) drives spotted owl reproductive output, and thinning smaller trees could improve subcanopy flight zone, thereby increasing MSO foraging effectiveness.

The amendment is consistent with forest plan goals for wildlife and fish. The project would improve habitat quality and diversity in both the short and long term and provide quality old-growth habitats (Kaibab National Forest forest plan, page 12). It would improve habitat for listed threatened, endangered, or sensitive species of plants and animals and work toward recovery and delisting of species (Kaibab National Forest forest plan, page 18). The amendment is consistent with goals and objectives of the recovery plan to provide continuous replacement nest habitat over space and time, and by identifying stands that have the potential to reach target conditions and whose current conditions most closely approach those conditions (USDI 1995).

The amendment removes language that addresses pre- and post-treatment, population and habitat monitoring and replaces it with language that focuses on implementing the requirements in the FWS biological opinion. Delaying treatment in PACs would leave occupied MSO habitat at risk of loss from high-severity fire. Arizona's two largest fires account for nearly a million and half acres of forested land burned since 2002. Both fires included high-severity fire in PAC habitat. Other fires burning in the Upper Gila Recovery Unit have charred additional acres of MSO protected habitat. Most climate models suggest that the Southwest will experience higher temperatures and increased variability in precipitation, which will significantly affect fire regimes and forest health (Aumack et al. 2007).

The FWS urges a deliberate and cautious approach to management activities within PACs (USDI 2012). Silvicultural modeling of the proposed treatments indicates limited change to forest structure after implementation. However, the treatments are expected to include increased tree growth rates to reduce the time needed for developing large trees (defined as 18-inch d.b.h. and greater in the current recovery plan for the MSO), maintaining existing large trees, and decreasing surface fuels and increasing crown base height. Combined, this should develop and maintain MSO nesting and roosting habitat, a key aspect of the recovery plans, while decreasing risk of crown fire.

Forest restoration and fuels reduction treatments would be evaluated over time. Monitoring would be designed and implemented to evaluate the effects of prescribed fire and hazardous fuel reduction treatments on spotted owl habitat, and to retain or move toward MSO desired future conditions as described in the draft recovery plan. The details on accomplishing the monitoring goals will be developed specifically for this approach through coordination with the FWS under formal consultation, as described in the ESA. In this way, work to protect and improve owl habitat can be accomplished in a timely manner while emphasizing monitoring and feedback loops to allow management to be adaptive. For these reasons, the amendment as it relates to pre- and post-treatment, population, and habitat monitoring is consistent with forest plan goals and objectives.

Designating target or threshold habitat in the project with the best potential would move toward desired percentages in restricted (recovery) habitat, consistent with forest plan goals and objectives.

Relationship to Management Prescriptions: The intent of managing 2,247 acres of restricted habitat to current or future threshold conditions and managing 2,090 acres toward 110 to 150 basal area is consistent with the management emphasis of providing for multiple uses that includes wildlife habitat and meeting MSO standards and guidelines which emphasize improving and maintaining the quality of the habitat and moving ponderosa pine toward desired forest structure, including MSO habitats (table 110). Both actions affect 1 percent or less of GA 2.

Table 110. Alternative B Kaibab NF Amendment 2 Geographic Area (GA) Acres

GA	GA Description	Forestwide Acres	Proposed Amendment Acres	Forestwide Acres Affected (Percent)
Manage Restricted Habitat for 110 to 150 Basal Area				
GA-2	Williams Forestland	308,394	2,090	< 0.01
Manage Restricted Habitat for Future Threshold Conditions				
GA -2	Williams Forestland	308,394	2,247	1

Relationship to Outputs: In comparison to the forest's total suitable timber lands (479,132 acres), the amendment would affect less than 0.01 percent of those lands. For this reason, mechanical treatment and management within current MSO threshold or future threshold (i.e., target) habitat would not measurably increase or decrease timber outputs or firewood availability. There would be no measurable effect to outputs from deferring the final design of treatments and monitoring to the project's biological opinion. The amendment would not affect decisions that have been made through separate analyses on grazing capacity or permitted livestock use.

Alternative D – Coconino National Forest Site-Specific Nonsignificant Forest Plan Amendments

Three nonsignificant, site-specific forest plan amendments are proposed for alternative D.

Amendment 1. MSO Habitat Management (Coconino NF)

Amendment Description

This amendment is the same as described for alternative B. Although alternative D reduces the acres that would receive prescribed fire, the amendment would still be required to address mechanical treatment above 9-inch d.b.h., eliminating incremental treatments within PACs, and deferring monitoring to the project's FWS biological opinion.

Amendment 2. Management of Canopy Cover and Ponderosa Pine With an Open Reference Condition Within Goshawk Habitat (Coconino NF)

This amendment is the same as described for alternative B. The key difference between the alternatives is the acres that would receive prescribed fire. In alternative D, the acres of prescribed fire would be reduced from 587,923 acres in alternative B to 178,790 acres. Any difference in acres of prescribed fire would not eliminate the need for a plan amendment that addresses managing acres for an open reference condition.

Amendment 3. Effect Determination for Cultural Resources (Coconino NF)

Amendment 3 is the same as described for alternative B. The reduction in acres to receive prescribed fire in alternative D would not eliminate the need for a plan amendment that addresses managing for "no effect" or "no adverse effect" for heritage resources.

Alternative D – Kaibab National Forest Site-Specific Nonsignificant Forest Plan Amendments

Two nonsignificant forest plan amendments are proposed in alternative D.

Amendment 1. Management of Canopy Cover and Ponderosa Pine With an Open Reference Condition Within Goshawk Habitat (Kaibab NF)

This amendment is similar alternative B. However, the acres to be managed for an open reference condition in alternative D would be reduced by about 40 acres when compared to alternative B. The effects of managing for a reduced number of acres (40 acres) is not measurable. The significance evaluation findings are the same as described in alternative B.

The key difference between alternative B and alternative D are the acres that would receive prescribed fire. In alternative D, the acres of prescribed fire would be reduced from 587,923 acres in alternative B to 178,790 acres. Any difference in acres of prescribed fire would not eliminate the need for a plan amendment that addresses managing acres for an open reference condition.

Amendment 2. MSO Habitat Management (Kaibab NF)

This amendment is the same as described for alternative B. Although alternative D reduces the acres that would receive prescribed fire, the amendment would still be required to eliminate incremental treatments within PACs, defer monitoring to the project's FWS biological opinion, and manage the project area for less than 10 percent restricted habitat.

Appendix C – Design Features, BMPs, and Mitigation

Design features, BMPs, and mitigation that are common to all action alternatives (B–D) are presented for each resource with one exception. Silviculture design features can be found in Appendix D – Implementation Plan.

Table 111. Alternatives B, C, and D design features, best management practices, and mitigation

Design Criteria No.	Description	Purpose: Forest Plan Compliance	Purpose: Specialist Recommen-dation	Comment or Purpose
Aquatics				
A1	See Soil and Water: SW1 to SW 34 and Fire Ecology: FE2			
Botany				
B1	Follow forest plan direction for special areas including botanical areas and research natural areas.	X		Preserve special features and meet intent of designation.
B2	Determine potential occurrences and habitat of Southwestern Region sensitive plants in potential activity areas when planning for implementation. Identify potential species and survey the area to be treated before implementation.	X		Complies with FSM direction 2670. Manual direction (FSM 2670.5(19)) emphasizes that management actions should avoid or minimize impacts to sensitive species.
B3	Mitigate negative effects from management actions on Southwestern Region sensitive plants during design and implementation.	X		Complies with FSM direction, minimizes impacts to Southwestern Region sensitive plants.
B4	Prohibit slash pile construction within populations of Southwestern Region sensitive plants. Construct slash piles at least 10 to 20 feet away from known populations of Southwestern Region sensitive plants. Place slash piles on previously used locations such as old piling sites, old log deck sites, or other disturbed sites to avoid severe disturbance to additional locations where possible. Monitor slash pile sites after burning and control noxious or invasive weeds (see FE10).		X	Mitigates effects of disturbance and burning. Reduces loss of native seed bank, limits extent of severe disturbances, and reduces severely disturbed sites that are more prone to invasion by noxious or invasive weeds.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
B5	Prohibit temporary road construction and reconstruction, tracked vehicles, and pits within populations of Southwestern Region sensitive plants.		X	Eliminates direct loss of plants.
B6	Prohibit construction and reconstruction of log landings in identified populations of Southwestern Region sensitive plants.	X		Mitigates effects of disturbance. Follows management plan guidance of the management plan for *Hedeoma diffusum* (Flagstaff pennyroyal).
B7	Follow the guidance of the "Arizona Bugbane Conservation Assessment and Strategy, Coconino and Kaibab NFs" (1995) when planning activities near Arizona bugbane populations. An example of mitigation for this species includes preservation of shade and cool microsites for existing populations. This may require special attention in upland areas near canyon edges.	X		Mitigates effects to Arizona bugbane, a FWS candidate species. Follows guidance of conservation assessment and strategy and complies with policy.
B8	Manage fire severity in all entries in or near Arizona bugbane populations to minimize tree mortality.	X		Preserves the shady, mesic environment and overstory needed for Arizona bugbane.
B9	Follow the guidance of the management plan for *Hedeoma diffusum* (Flagstaff pennyroyal) when working in suitable habitat for this species. Examples of mitigations include restrictions on distance for building temporary roads near existing populations.	X		
B10	Deferrals and groups may include Southwestern Region sensitive plant groups where practical, using areas not occupied by the plants as interspaces.		X	Provide protection and shade needed by the sensitive plants while allowing for the least impact on clump/group/interspace design and layout during implementation and help mitigate impacts to Southwestern Region sensitive plants.
B11	Survey springs and channels for Southwestern Region sensitive plants before implementation and identify locations. Inform the forest botanist if new locations are found and mitigate effects to plants and populations. Mitigations include avoiding plants, altering designs, or including plants	X		Protects populations and habitat of Southwestern Region sensitive plants. Protects sneezeweed since it grows in ephemeral stream courses, springs, ponds, stock tanks,

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
	in enclosures. Incorporates buffer strips along drainages. See soil and water SW8.			and meadows.
B12	Survey springs and channels for Bebb's willow before implementation and identify locations. Inform the forest botanist if new locations are found and mitigate effects to plants and populations. Mitigations include avoiding plants, altering designs, or including plants in enclosures. Identify opportunities to enhance Bebb's willow where plants are decadent or dying. Manual grubbing of grasses may be used to increase the likelihood of planting success.	X – Coconino NF only		Protects populations and habitat of Bebb's willow. Bebb's willow stands would be enhanced by using cuttings, planting locally cultivated plants, and fencing existing or newly planted willows.
B13	Manage prescribed burns to promote native species and to hinder weed species germination.	X		Promote healthy native plant communities and reduces the risk of noxious or invasive weed invasions.
B14	Fire lines would be placed around Bebb's willows and dead branches within the clumps would be removed before prescribed burning adjacent areas to reduce the risk of fire impacting willows. Also see FE5.		X	Aids in restoring Bebb's willow which is a Southwestern Region sensitive species for the Coconino NF and a rare species on the landscape for both forests.
B15	Follow the guidance in appendix B of the "Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds, Coconino, Kaibab, and Prescott NFs within Coconino, Gila, Mojave, and Yavapai Counties, Arizona" including: (1) surveying the treatment area and evaluating weeds present before implementation; avoiding or removing sources of weed seed and propagules to prevent new weed infestations and the spread of existing weeds; (2) treating weed infestations within treatment units before implementing treatments; (3) managing prescribed fires as an aid to control of existing weed infestations and to prevent the spread of existing weeds; and (4) monitoring slash pile sites after burning and control noxious or invasive weeds.	X		Provides guidance and mitigation for noxious or invasive weeds and complies with amendment 20 of the Coconino NF forest plan and amendment 7 of the Kaibab NF forest plan.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
B16	Incorporate weed prevention and control into project layout, design, alternative evaluation, and project decisions. Prevent spread of potential and existing noxious or invasive weeds by vehicles used in management activities by washing vehicles and equipment prior to entering the project area and when moving from one area to another. Review timber sale contract clauses for vehicle cleaning and incorporate appropriate clauses. Also see SW4 for timber sale clauses and FE10 that addresses preventative measures for weeds from prescribed burning.	X		Mitigate effects of management actions on existing and potential noxious or invasive weed infestations; measure is complementary to timber sale contract clause CT WO-C/CT 6.36 and watershed best management practices.
Fire Ecology				
FE1	Burn unit size, as well as strategic placement, would be a consideration in designing units and implementation prioritization (Finney et al. 2003).		X	Arrangements of large treatment areas are more effective at reducing fire behavior than arrangements of smaller ones. Larger burn blocks, when possible, would also be mitigation for emissions by increasing the potential number of acres that could be burned in a burn window. Larger burn units would produce more smoke when prescribed fires are implemented, but for a shorter duration.
FE2	Prescribed fire (pile, broadcast, and jackpot burning) would occur in accordance with ADEQ requirements. Coordination with ADEQ would take place through the Kaibab and Coconino NF Zone Dispatch Center and the prescribed burn boss.	X		Regulatory requirement.
FE3	Emission reduction techniques (ERT) (see FE8) would be utilized when possible to minimize impacts to sensitive receptors of burn unit(s). Project design for prescribed fire and strategies for managing wildfires should incorporate as many emission reduction techniques as feasible, subject to economic, technical, and safety criteria, and land management objectives. Decision documents (which define the objectives and document line officer approval of the strategies chosen for wildfires) should identify smoke sensitive receptors, and include objectives and		X	ERTs are recommended by the ADEQ as techniques that can be effective for minimizing impacts to sensitive receptors.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
	courses of action to minimize and mitigate impacts to those receptors as feasible.			
FE4	As needed, the burning of hand piles or machine piles would occur when conditions are favorable and risk of fire spread is low. Piles would be located far enough away from residual trees and shrub patches to minimize canopy scorch or damage to ponderosa pine or large oak (>6″ d.b.h.) where it is not desirable. Individual piles or groups of piles may have fire line cut around them if necessary to meet objectives.		X	Prevent undesirable impacts.
FE5	Fire line construction may consist of removing woody and/or herbaceous vegetation, removing surface fuels, pruning, or cutting breaks in fuels by hand, ATV (drag lines), or a dozer as needed; (2) fire line width would be determined as adjacent fuels and expected fire behavior dictate, as well as compliance with the requirements of cultural, wildlife, and other resource areas; (3) constructed fire lines would be rehabilitated, which may include pulling removed material back into the lines, hand constructing water diversion channels and/or water bars, laying shrubs or woody debris in the lines following burning, or other methods appropriate to the site.		X	Facilitate broadcast burns or pile burning operations.
FE6	Mechanical treatments following broadcast burns would occur after surface vegetation has recovered sufficiently to minimize impacts from the mechanical treatments (generally 1 to 3 years). Prescribed fire treatments following mechanical treatments would occur after there has been adequate surface vegetation recovery that fuel loads are sufficient to meet the objectives of a prescribed burn.		X	Minimize impacts from mechanical treatments on vegetation and soil.
FE7	Prescribed fires may be conducted before or after mechanical treatments. The sequencing of prescribed fires and mechanical treatments would be decided on a site-specific basis, depending on the site, burn windows, available resources, thinning schedules, etc.		X	Increase the flexibility for implementing both prescribed fire and mechanical treatments.
FE8	The following ADEQ ERTs would be used when practicable to minimize impacts to sensitive receptors: pre-burn fuel removal, mechanical		X	Reduce emissions from prescribed fire.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
	processing, increased burning frequency, aerial/mass ignition, high moisture in large fuels, rapid mopup, air curtain incinerators, burn before greenup, backing fire, maintain fire line intensity, underburn before litterfall, isolating fuels, concentrating fuels, mosaic/jackpot burning, moist litter and duff, burn before large activity fuels cure, and utilize piles.			
FE9	Mitigation and design features for smoke impacts include: (1) Reducing the emissions produced for a given area treated, (2) Redistributing/ diluting the emissions through meteorological scheduling and by coordinating with other burners in the airshed. Dilution involves controlling the rate of emissions or scheduling for dispersion to assure tolerable concentrations of smoke in designated areas, and (3) Avoidance uses meteorological conditions when scheduling burning in order to avoid incursions of wildland fire smoke into smoke sensitive areas. Also see FE8 for ERTs.			Reduce emissions from prescribed fire.
FE10	When prescribed burns are conducted in areas with, or near known populations of invasive weeds, followup monitoring would be conducted. Also see Botany B4.		X	Detect new weed infestations before they spread.
FE 11	See Rangeland Management: R1, R4, and R5.		X	Prevent damage or loss of infrastructure.
FE12	When practicable, damage or mortality to old trees and large trees would be mitigated by implementing prescription parameters, ignition techniques, raking, wetting, thinning, compressing slash, or otherwise mitigating fire impacts to the degree necessary to meet burn objectives and minimize fire line intensity and heat per unit area in the vicinity of old trees. Trees identified as being of particular concern (e.g., trees with known nests or roots for herons, eagles, osprey, or other raptors, occupied nest cores, or critical areas in PACs) would be managed in accordance with wildlife design features (see wildlife). Prepare old trees 1 year or more before a burn if possible.		X	Old trees and large trees are rare components and are underrepresented across the analysis area. Implementing mitigation measures when possible is a critical component of restoration on a landscape scale. Large trees that are not old are not as susceptible to damage from fire. Mitigation measures that can be implemented a year or more before a burn, such as thinning or raking, may improve the health of the tree, improving its response to fire.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
FE13	Mitigation measures and design features for wildlife species including MSO, golden eagle, bald eagle, pronghorn, northern goshawk, bats, northern leopard frog, turkey, deer, and other wildlife can be found in the wildlife section.			
FE14	Aspen, Gambel oak, pine-sage: fire effects would be managed primarily by implementing prescriptions and ignition techniques to meet objectives in pine-sage systems. In Gambel oak, avoid lighting near the bases of large oak boles.		X	To meet burn objectives.
FE15	Concerned/interested public will be given as much warning as possible in advance of prescribed burns via notices, press releases, email lists, public announcements, phone lists, or other notification methods as appropriate.		X	To provide advanced notice for publics concerned about potential impacts from emissions resulting from prescribed fires.
Heritage Resources and Tribal Relations				
HR/TR-1	The forest would comply with the NHPA for all ground-disturbing undertakings. Effects to cultural resources would be determined in consultation with the SHPO and other consulting parties. Potential effects would be addressed through site avoidance strategies and implementing the site protection measures listed in the Southwestern Region programmatic agreement (PA), appendix J and in the 4FRI heritage strategy and section 106 clearance report.	X		Regulatory requirement. Compliance with NHPA and Southwestern Region PA with AZ SHPO.
HR/TR-2	Consult with Native Americans in compliance with NHPA, AIRFA, EO 13007, EO 13175, and other applicable Executive Orders and legislation, particularly when projects and activities are planned in sites or areas of known religious or cultural significance.	X		Regulatory requirement. Compliance with NHPA and Southwestern Region PA with AZ SHPO.
HR/TR-3	Project undertakings would be inventoried for cultural resources and areas of Native American religious and cultural use.	X		Regulatory requirement. Compliance with NHPA and Southwestern Region PA with AZ SHPO.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
HR/TR-4	Eligible, or potentially eligible, cultural resources would be managed to achieve a “no effect” or “no adverse effect” determination whenever possible, in consultation with the SHPO and ACHP (36 CFR 800).	X		Regulatory requirement. Compliance with NHPA and Southwestern Region PA with AZ SHPO.
HR/TR-5	Monitoring during and after project implementation would occur to document site protection and condition. Also see FE5.	X		Forest plan compliance.
HR/TR-6	See Recreation and Scenery RS3 and RS5 for mitigation related to historic roads and trails.	X		Forest plan compliance.
HR-TR-7	Prior to initiating project-specific task orders, the forests would consult with federally recognized tribes to identify traditional use areas and, if necessary, develop project-specific mitigation measures to accommodate traditional use of the forest by tribal members.	X		
HR-TR-8	When areas are selected for treatment, detailed maps of the area would be presented to tribes through ongoing tribal consultation to determine if other sensitive areas of tribal importance could be potentially impacted.	X		
HR-TR-9	Treatment timing would be adjusted to coincide with seasonal plant gathering and ceremonial use.	X		
HR-TR-10	See FE 5	X		
Rangeland Management				
R1	Historic range monitoring sites including witness trees/posts, 1″ angle iron stakes, and any other site location markers would be protected. These sites would not be excluded from treatment but care needs to be taken to avoid loss of these site markers. These sites would not be used as locations for temporary access roads, skid trails, landing areas, or large slash piles.		X	Avoid site damage.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
R2	The sale administrator would work closely with the district range staff to determine pasture use during harvest activities.		X	Avoid infrastructure damage, and retain allotment and pasture fences within a harvest area.
R3	All fences in the cutting area would be protected from harvest activities. Skid trail layout would keep equipment on one side of the fence to avoid having to cut fences. Temporary cattle guards would be installed on all haul roads where gates exist within active grazed pastures. All cattle guards on harvest haul roads would be maintained throughout hauling activities.		X	Protect infrastructure.
R4	Burning often damages/destroys wood stays and h-brace posts in existing pasture/allotment fencing. Protection of these fences is critical for implementation of planned grazing systems and is important to reduce the costs of replacing these items. Even with protection, wood stays and h-braces would be damaged by the fire. The cost of prescribed burning would include fence protection measures and replacement/reconstruction costs for burned wood stays and h-braces. Fire personnel will look at using the fence lines as burn area boundaries whenever possible to reduce these impacts.		X	Limit the numbers of pastures affected by the fires in a given year. Protect fences that are critical to the implementation of planned grazing systems and reduce the costs of replacing these items.
R5	Fire personnel would coordinate with district range staff to schedule main pasture burning to limit impacts to allotment grazing management. The general goal would be to limit burns to no more than one main grazing pasture/year/allotment in allotments with a less than, or equal to, six pasture grazing system. The general goal would be to limit burns to no more than two main grazing pastures/year/allotment in allotments with a greater than six pasture grazing system. Main pastures are pastures that are large enough to hold the allotments livestock for more than an average of 20 days per year. This is a general rule of thumb; however, each allotment has specific situations that would need to be addressed.		X	Minimize disruption to grazing.

Design Criteria No.	Description	Purpose: Forest Plan Compliance	Purpose: Specialist Recommen-dation	Comment or Purpose
R6	Restrictions in grazing of livestock would primarily occur after prescribed fire in a pasture. Post-fire grazing may resume within a pasture when soil and perennial plants, that would likely be grazed, would not be permanently damaged by livestock. The range management definition for this is range readiness. Plants are ready for grazing when at least one of the following characteristics is present: (1) seed heads or flowers, (2) multiple leaves or branches, and/or (3) a root system that does not allow plants to be easily pulled from the ground. These characteristics provide evidence of plant recovery, high vigor, and reproductive ability. An estimate of this restriction is not available because each pasture and burn is unique. Climatic conditions, soils, vegetation, burn intensity, burn amount, and pasture management can vary greatly from year to year or from pasture to pasture.		X	Assessment of post-fire range readiness.
R7	The removal or exclusion of livestock water would be mitigated with alternative water sources, providing lanes to the water, or piping water to a livestock drinker.		X	Provide alternate water sources.
Recreation, Trails, Scenery, and Special Areas				
RS1	**Edges of Individual Units:** (a) Edges of treatment units would be shaped and/or feathered to avoid abrupt changes between treated and untreated areas; (b) where the treatment unit is adjacent to denser forest (treated or untreated), the percent of thinning within the transition zone (150–250′) would be progressively reduced toward the denser edges of the unit; (c) where the treatment unit interfaces with an opening (including savanna and grassland treatments, and natural openings) the transition zone would progressively increase toward the open edges of the unit; (d) soften edges by thinning adjacent to the existing unit boundaries. Treat up to the edges; do not leave a screen of trees. Favor groups of trees complying with the prescribed treatment that visually connect with the unit's edge to avoid an abrupt and noticeable	X	X	Compliance with forest plans.

<table>
<tr><th rowspan="2">Design Criteria No.</th><th rowspan="2">Description</th><th colspan="2">Purpose</th><th rowspan="2">Comment or Purpose</th></tr>
<tr><th>Forest Plan Compliance</th><th>Specialist Recommen-dation</th></tr>
<tr><td></td><td>change; (e) treatment boundaries should extend up and over ridgelines to avoid the “mohawk” look; and (f) avoid widely spaced individual trees that are silhouetted along the skylines.</td><td></td><td></td><td></td></tr>
<tr><td>RS2</td><td>Unit Marking: (a) Avoid using trails as boundaries and (b) avoid abrupt changes between treatment units. Use the techniques suggested for edges of treatment units (above).</td><td>X</td><td>X</td><td>Compliance with forest plans.</td></tr>
<tr><td>RS3</td><td>Road, Skid Trail, and Landing Construction: (a) Utilize dust abatement methods during haul of logs on the following roads shown in the table during the season when dust is likely and funding is available. Coordinate with Coconino County on the application and timing of application of dust abatement on road segments that have county maintenance responsibilities:
<table>
<tr><th>Road Number</th><th>Beginning Milepost</th><th>Ending Milepost</th><th>Segment Length</th></tr>
<tr><td>556</td><td>0.734</td><td>1.245</td><td>0.511</td></tr>
<tr><td>418</td><td>0.004</td><td>1.004</td><td>1</td></tr>
<tr><td>418</td><td>1.697</td><td>2.372</td><td>0.675</td></tr>
<tr><td>0716B</td><td>0</td><td>0.76</td><td>0.76</td></tr>
<tr><td>140</td><td>5.657</td><td>6.158</td><td>0.501</td></tr>
<tr><td>141</td><td>3.134</td><td>3.431</td><td>0.297</td></tr>
<tr><td>141</td><td>14.303</td><td>14.963</td><td>0.66</td></tr>
<tr><td>141</td><td>31.487</td><td>33.968</td><td>2.481</td></tr>
</table>
(b) Where new temporary roads and skid trails meet a primary travel route, they should intersect at a right angle, then curve after the junction to minimize the length of route seen from the primary travel route; (c) Log landings, temporary roads, and skid trails should be minimized within sensitive viewsheds; (d) Highest emphasis would be placed on foreground (up to 300 feet) of</td><td>X</td><td>X</td><td>Compliance with forest plans.</td></tr>
</table>

Design Criteria No.	Description	Purpose: Forest Plan Compliance	Purpose: Specialist Recommen-dation	Comment or Purpose
	developed recreation sites, private homes or communities, and concern level 1 roads (paved roads and passenger car level roads); (e) Log landings, skid trails, and temporary roads would be rehabilitated including restoring proper drainage and reseeding as needed with native species, and trails, especially those designated as national scenic, historic, or recreation trails; (f) GPS the log landings for post-treatment consideration for parking or dispersed camping; (g) To hasten recovery and help eliminate unauthorized motorized and nonmotorized use of skid trails and temporary roads, use physical measures such as recontouring, pulling slash and rocks across the line, placing cull logs perpendicular to the route, and disguising entrances; (h) Avoid using FS designated trails as skid trails or for temporary roads; (i) National scenic, historic, and recreation trails as well as forest system trails (motorized and nonmotorized) would not be used for temporary roads or skid trails. It is acceptable to make perpendicular trail crossings. The locations of crossings would be designated. Trail crossings would be restored to pre-project condition after use; (j) Crossing of the Arizona Trail would be done sparingly and only if no other alternative exists. These crossing locations would be coordinated with district recreation staff; and (k) Large, upright trail cairns used on Beale Wagon Road and Overland Trail must be protected. Locate cairns ahead of time. Logging operations would not damage the cairns.			
RS4	**Cull Logs, Stump Heights, and Slash Treatments**: **Cull logs** would not be abandoned on landings. Use cull logs for closing temporary roads and decommissioning roads. Cull logs may also be suitable to use as down woody material, but must be scattered away from the landings. **Stump heights** should be cut as low as possible, with a maximum height of 12 inches. In the foreground of sensitive roads, trails, recreation sites, private homes/ communities, strive to make stump heights 6″ or lower, with 12″ heights as the exception, and rarely occurring. **Slash** must be	X	X	Compliance with forest plans.

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	treated or removed. In the seen area immediate foreground of sensitive places (within 300′ of the centerline of concern level 1 roads or trails, or 300′ from the boundary of a recreation site or private land/communities) where whole tree logging occurs, machine piling may occur to the back of log landings. If conventional logging is used and trees are delimbed and topped in the forest, machine piled slash should be placed at least 300 feet away from the centerline of roads and trails, developed recreation sites, or private land/communities. In these instances, piles should be burned as soon as possible or within 3 years. Root wads and other debris in sensitive foreground areas would be removed, buried, burned, or chipped. If materials are buried, locate in previously disturbed areas where possible. Beyond sensitive immediate foreground areas, it is acceptable to scatter these or use them to help close temporary roads or skid trail. If slash is not removed in grassland treatment areas, it is acceptable to create machine piles 300 feet away from the centerline of sensitive roads and trails, developed recreation sites, and private land/communities, and place project-generated slash outside of permitted utility line and pipeline rights-of-way; do not interfere with utility corridor management.			
RS5	**Fire Control Lines**: (1) Generally restore control lines to a near undisturbed condition in the foregrounds (within 300′) of sensitive roads, trails, and developed recreation sites), (2) To hasten recovery and help eliminate unauthorized motorized and nonmotorized use of control lines in these areas, use measures such as recontouring, pulling slash and rocks across the line, and disguising entrances, and (3) Do not use motorized equipment on national scenic, historic and recreation trails, or other forest system trails if these are used for control lines. Coordinate with the district recreation staff regarding use of national trails as control lines.	X	X	Compliance with forest plans.

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RS6	Coordinate with landscape architect prior to implementing jackstraw, spring, and road restoration treatments. Also see SW37 and T8.	X	X	Maintain scenic integrity.
RS7	**Recreation and Other Trail Mitigation:** a) Recreation Sites (i) Proposed mechanical treatments and prescribed fire adjacent to developed recreation sites must be reviewed and approved by the district ranger. Treatments may occur within Ten-X, Kaibab Lake and White Horse Lake Campgrounds. Work with the district recreation staff to determine boundaries or no treatment zones around constructed features that need to be protected in the campgrounds. Treatments around the perimeter of the campgrounds are encouraged. The timing of treatments must be worked out with districts. Treatment would generally occur in fall, winter, or spring. Activity slash must be piled in agreed upon locations, and treated as soon as possible. If campgrounds remain open into fall and winter, provide information about upcoming closures and management activities onsite, at FS offices, and FS Web sites. (ii) Thinning and burning is appropriate at Garland Prairie Vista and Oakhill Snowplay Area, but constructed features must be protected from damage. Work with the district recreation staff to establish boundaries to protect constructed features. (b) Provide public notice and information about treatment locations, timing, and the type of treatment occurring prior to and during vegetation and fire treatments. (i) Consider use of a hotline or link on our Web pages that would indicate closures or hazards that may be encountered, also use media and make sure frontliners are well informed	X	X	Compliance with forest plans, inform public, and reduce impacts to recreational opportunities.

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	about activities occurring on the districts and forests. (c) Place warning signs on all trail access points and along trails where treatment activities are occurring. It is also appropriate to place warning signs at developed recreation sites to inform visitors. (d) When mechanical treatment and burning are occurring along open trails, slash will be pulled back immediately within 100 feet of the centerline of the trail corridor. (e) If trails are temporarily closed due to harvesting, the trail tread will be cleared of all slash. (f) Character trees that have unique shape or form, and trees that define the trail corridor should be retained where feasible and should conform to the applicable prescription. Avoid lines of trees; strive to achieve a groupy appearance to avoid abrupt changes in the landscape character along the trail corridor. (g) Implement road closures, one-way traffic, and area closure restrictions as deemed necessary by forest officials for health and safety concerns during any operation, and (h) Prohibit treatment activities in specifically designated units and the forest system roads associated with these units during times of highest recreation use. The highest recreation use and associated traffic occurs during the weeks of Federal observed Memorial Day, July 4th, and Labor Day.			
RS8	**In Semiprimitive NonMotorized ROS classes specifically**: (1) Temporary roads should not (generally) be built. If they are used, they would be restored to original conditions when projects are completed, (2) Strive to make stumps 6″ or lower throughout the area, 12″ stumps are the exception and rarely occur, (3) Slash must be treated or removed in these areas, and (4) Use existing barriers (roads) and natural barriers as control lines whenever possible.	X		Compliance with forest plans.

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RS9	Cave and karst protection, see W40	X		
RS10	See SW21, SW37, W46, and W47 for additional fence mitigation.		X	
Silviculture – See Appendix D, Implementation Plan				
Soils and Watershed				
SW1	Implement best management practices prior to project implementation.	X		Minimize impacts to soil and water resources from project implementation, to minimize nonpoint source pollution, to adhere to the Clean Water Act, and to adhere to the intergovernmental agreement between the Southwestern Region of the Forest Service and the ADEQ.
SW2	Minimize mechanical operations when ground conditions are such that soil compaction can occur. All activities should be limited/restricted to when soils are dry or frozen. If compaction occurs, mitigate through ripping, seeding, and covering compacted areas with slash.	X		Minimize soil compaction, soil detachment, and sediment transport. To maintain long term soil productivity.
SW3	All fueling of vehicles would be done on a designated protected, upland site. If more than 1,320 of gallons of petroleum products are to be stored onsite above ground or if a single container exceeds 660 gallons, then a spill prevention control and countermeasures plan (SPCC) would be prepared as per 40 CFR 112.	X		Prevent contamination of waters from accidental spills.
SW4 has more info than BMP 4	The following applies to any personnel implementing ground-disturbing actions: Prior to moving off-road equipment onto a project area, contractor shall identify the location of the equipment's most recent operation. Contractor shall not move any off-road equipment that last operated in an area infested with one	X		Minimize the spread of nonnative species.

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	or more invasive species of concern onto the sale area without having cleaned such equipment of seeds, soil, vegetative matter, and other debris that could contain or hold seeds, and having notified the Forest Service, as provided in (iii). If the location of prior operation cannot be identified, then contractor shall assume that the location is infested with invasive species of concern. If the contractor has worked in areas where potential chytrid fungus could occur, contractor shall assume chytrid fungus is present and must disinfect equipment prior to work adjacent to water bodies. (i – intentionally omitted) (ii) Prior to moving off-road equipment from a cutting unit or cutting area that is shown on contract area or sale area map to be infested with invasive species of concern to, or through any other area that is shown as being free of invasive species of concern, or infested with a different invasive species, contractor shall clean such equipment of seeds, soil, vegetative matter, and other debris that could contain or hold seeds and/or disinfect as necessary, and shall notify the Forest Service, as provided in (iii). (iii) Prior to moving any off-road equipment subject to the cleaning and disinfecting requirements set forth above, contractor, shall advise the Forest Service of its cleaning measures and make the equipment available for inspection. Forest Service shall have 2 days, excluding weekends and Federal holidays, to inspect equipment after it has been made available. After satisfactory inspection or after such 2-day period, contractor may move the equipment as planned. Equipment shall be considered clean when a visual inspection does not disclose seeds, soil, vegetative matter, and other debris that could contain or hold seeds. Contractor shall not be required to disassemble equipment unless so directed by the Forest Service after inspection. (iv) If contractor desires to clean off-road equipment on national forest land, such as at the end of a project or prior to moving to, or			

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	through an area that is free of invasive species of concern, contractor shall obtain prior approval from contracting officer as to the location for such cleaning and measures, if any, for controlling impacts.			
SW5	If construction crews are to live onsite, then an approved camp and suitable sanitation facilities must be provided.		X	Protect surface and subsurface water from unacceptable levels of bacteria, nutrients, and chemical pollutants.
SW6	On areas to be prescribed burned, fire prescriptions should be designed to minimize soil temperatures over the entire area. High severity fire should occur on no more than 10 percent of the treatment area. Fire prescriptions should be designed so that soil and fuel moisture temperatures are such that fire severity is minimized and soil health and productivity are maintained. If containment lines are put in place, rehabilitate lines after use by either rolling berm back over the entire fire line, spreading slash across the fire line, or waterbarring the fire line. If line is only to be waterbarred, disguise the first 400′ of line to discourage use as a trail.	X	X	Maintain long term soil productivity and minimize sediment delivery from containment lines.
SW7	On areas to be prescribed burned, manage for 5–7 tons per acre of CWD in ponderosa pine to maintain long term soil productivity outside of the buffers around private land. Within the pinyon-juniper cover type, snags would be managed for one per acre over 75 percent of the area and CWD would be managed for an after-treatment average of 1–3 tons per acre (Huffman personal communication 2012). Where available, a portion of the CWD would include two logs ≥10″ and ≥10′ in length.	X	X	Maintain long term soil productivity.
SW8	On areas to be prescribed burned, establish filter strips (also known as streamside management zones). These stream reaches would be designated as protected stream courses. The following are recommendations to protect stream courses.	X		Minimize sediment and/or ash delivery into drainages and maintain water quality.

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	Riparian stream course: Severe erosion hazard: 120′ on each side of stream course. Moderate erosion hazard: 100′ on each side of stream course. Slight erosion hazard: 70′ on each side of stream course. **Nonriparian stream course**: Severe erosion hazard: 100′ on each side of stream course. Moderate erosion hazard: 70′ on each side of stream course. Slight erosion hazard: 35′ on each side of stream course. Do not ignite fuels within this buffer area. Some creep may occur into the buffer (also see SW31).			
SW9	Complete all required permitting (404 permits) and water quality certification (if necessary) prior to project implementation.	X		Comply with Clean Water Act provisions.
SW10	Site rehabilitation on upland sites for stream channel and road rehabilitation projects where ground disturbance occurs: seed at 5 pounds per acre with native, certified weed-free seed mix. Potential vegetation for individual sites should utilize the Kaibab and Coconino NFs TES to identify species to be utilized. Where feasible, protect site with slash spread across the disturbed area to create microclimates and protect from grazing ungulates.	X	X	To minimize soil erosion and minimize noxious weed spread.
SW11	Site rehabilitation on upland sites for stream channel and road reconstruction projects where ground disturbance occurs: seed at 5 pounds per acre with native, certified weed-free seed mix. Potential vegetation for individual sites should utilize the Kaibab and Coconino NFs TES to identify species to be utilized. Where feasible, protect site with slash spread across the disturbed area to create microclimates and protect from grazing ungulates.	X	X	To minimize soil erosion and minimize noxious weed spread and mitigate severe erosion hazard.
SW12	Site rehabilitation on riparian sites for stream channel and road reconstruction projects where ground disturbance occurs: seed at 5 pounds per acre with certified weed-free native seed mix to	X	X	To comply with State and Federal water quality standards by minimizing soil erosion through the stabilizing influence

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	rehabilitate the site and minimize impacts of noxious weeds. Potential vegetation for individual sites should utilize the Kaibab and Coconino NFs TES to identify species to be utilized. Where feasible, protect site with a variety of methods (e.g., ungulate proof fence, spreading slash, etc.).			of vegetation ground cover. Minimize noxious weed spread.
SW13	Install silt fences and/or waddles downstream from ground-disturbing activities in stream channels to minimize the chance of sediment being lost downstream during construction and until revegetation is completed.	X		Comply with State and Federal water quality standards by minimizing soil erosion through the stabilizing influence of vegetation ground cover. Minimize noxious weed spread.
SW14	Provide site protection on newly disturbed soils (e.g., hydromulch, erosion mat, spread slash etc.) in channel restoration and road reconstruction sites on all sites as needed and where feasible.	X		To comply with State and Federal water quality standards by minimizing sediment delivery to drainages, minimize impacts on severe erosion hazard soils, to create microclimate for regeneration of grass/forb community, and minimize noxious weed spread.
SW15	Bring rock material from a local upland site to any headcut drop structures that may be installed in channel restoration projects.	X		Minimize disturbance in drainage systems and minimize sediment production within channel.
SW16	Site rehabilitation on disturbed sites and stream channel shaping on previously obliterated roads: site rehabilitation consists of several revegetation methods, such as, but not limited to: (1) Store sod removed from the initial ground disturbance and replace the sod from the top of the bank on the disturbed site; (2) Seed with a native seed mix (see BMPs above); (3) Protect site with slash spread across the disturbed area to create microclimates and protect from grazing ungulates. Slash placement would be limited to the upper two-thirds of the bank to limit transport downstream of woody material; (4) Fence out ungulates for 1 to 2 years (or until the site has reestablished); (5) consider the use of mycorhizal	X	X	Comply with State and Federal water quality standards by minimizing soil erosion through the stabilizing influence of vegetation ground cover. Minimize noxious weed spread.

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	inoculum on severely disturbed sites where no topsoil is left; and (6) install erosion mat.			
SW17	Do not borrow road fill or embankment materials from the stream channel or meadow surface on road maintenance projects. End-load all material hauled onsite and compact fill.	X		Minimize disturbance in drainage systems and minimize sediment production within channel.
SW18	Where feasible, relocate roads out of filter strips into an upland position. If this is not feasible, use riprap or velocity checks to stabilize or disperse outfall on road maintenance projects when roads are located within filter strips.	X		Minimize sediment delivery into drainage, minimize disturbance in drainage systems, and minimize sediment production within channel.
SW19	At riparian stream reach restoration sites, restore riparian dependent grasses through (1) seeding of native species and (2) planting plugs of rushes, sedges, and spike rushes to improve success of regeneration efforts. Fence with ungulate proof fencing for 1 to 2 years (or until plants are established) if grazing is inhibiting regeneration efforts.	X		Comply with State and Federal water quality standards by minimizing soil erosion through stabilization of ground cover. Minimize noxious weed spread.
SW20	On areas that have had roads previously obliterated and the remaining roadbed will be removed, add slash/or erosion mat and seed to the disturbed areas.	X		Add surface roughness a to comply with State and Federal water quality standards by minimizing soil erosion through stabilization of ground cover and to diminish the impact of the first rain event and to speed recovery of the site.
SW21	At spring restoration sites, restore riparian dependent species through (1) seeding of native species and (2) planting plugs/cuttings of native plants to improve success of regeneration efforts. Fence with ungulate proof fencing for 1 to 2 years (or until plants are established) if grazing is inhibiting regeneration efforts. See W46 and W47 for additional fence mitigation.	X		Comply with State and Federal water quality standards by minimizing soil erosion through stabilization of ground cover. Minimize noxious weed spread.

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SW22	Do not blade roads when the road surface is too dry. If the road surface is too dry, a water truck can apply water or the project can be scheduled for when adequate moisture occurs to complete the project.	X		Minimize sediment detachment and to minimize impacts on severe erosion soils.
SW23	In grassland restoration sites, limit skidding and designate skid trails if wood is to be removed. Where material is not to be removed, do not skid logs in meadows, and lop and scatter is the preferred method of treating slash. Do not machine pile within meadows. If skidding has to occur across a riparian or nonriparian stream course, designate any crossing prior to skidding.	X		Minimize impacts to streams and soils in meadows from tree harvesting operations.
SW24	Skid trails and obliterated roads would have slash placed on the trail or cross-ditched (waterbarred) to break the energy flow of water. Placing slash on skid trails is the preferred method to dissipate the energy flow of water. Waterbars are only to be implemented with equipment with an articulating blade (no skidders) or by hand.	X		Minimize soil erosion and maintain soil productivity. Minimize impacts on severe erosion soils.
SW25	Landing locations will be in upland positions out of meadows and riparian and nonriparian filter strips.	X		Minimize sediment delivery into drainage and minimize impacts on severe erosion soils.
SW26	Mechanical harvest or mechanical fuel treatment are only allowed on cinder cones greater than 25 percent slope with designated skid trails and slash mats placed on the skid trails. On other sites, mechanized harvesting can occur up to 40 percent slopes.	X - Coconino NF only		Maintain long term soil productivity on slopes with severe erosion hazard potential.
SW27	Designated skid trails and log landings would be required within the Integrated Resource Service Contract (IRCS) (BMP 24.18 in FSH 2509.22) on all cutting units. Skid trail design should not have long, straight skid trails that would direct waterflow. Skid trails should also be located out of filter strips (exceptions are at approved crossings).	X		Minimize the number of acres disturbed and minimize impacts on severe erosion soils.

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SW28	Felling to the lead would be required within the IRSC to minimize ground disturbance from skidding operations (BMP 24.18).	X		Felling of timber should be done to minimize ground disturbance from skidding operations and to minimize impacts on severe erosion soils.
SW29	The IRSC outlines the timing and application of erosion control methods to minimize soil loss and sedimentation of stream courses. Seed mix can include any of the following certified weed-free native species at a minimum of 5 pounds per acre pure live seed. Potential vegetation for individual sites should utilize the Kaibab and Coconino NFs' TES to identify species to be utilized. Corresponding BMPs from FSH 2509.22 to minimize soil loss and sedimentation include 24.13, 24.21, 24.22, 24.23, 24.24, and 24.25. The preferred erosion control method on the skid trails in the harvest areas would be by spreading slash. Other acceptable erosion control measures include, but are not limited to, waterbarring (waterbars should not be more than 2′ deep and need at least a 10′ leadout). Waterbars are only to be implemented with equipment with an articulating blade (no skidders) or by hand to remove berms, seed, mulch, and cross-rip. Erosion control after skidding operations must be timely to minimize the effects of log skidding.	X		Minimize soil loss and sedimentation of stream courses from skidding operations. Minimize noxious weed spread and reestablish native vegetation. Minimize impacts on severe erosion soils.
SW30	Road drainage is controlled by a variety of methods (BMP 41.14) including rolling the grade, insloping, outsloping, crowning, water spreading ditches, and contour trenching. Sediment loads at drainage structures can be reduced by installing sediment filters, rock and vegetative energy dissipaters, and settling ponds. Design of roads is included in the transportation plan of the IRSC and T-specs.	X		Minimize soil movement, maintain water quality, and minimize impacts on severe erosion soils.
SW31	Road maintenance (BMP 41.25) through the IRSC should require pre-haul and post-haul maintenance on all roads to be used for haul.	X		To minimize soil movement, maintain water quality, and to minimize impacts on severe erosion soils.

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SW32	The designation of filter strips (also known as streamside management zones) minimizes onsite soil movement from timber harvest activities along stream courses (BMP 24.16). These stream reaches will be designated as protected stream courses. Locations of protected stream courses are included in the individual task order maps and will be designated with a protected stream course designation. The following are recommendations to protect stream courses within the proposed tree harvest units in relation to riparian and nonriparian stream courses. The guidelines for filter strip designation are as follows: **Riparian stream course**: Severe erosion hazard: 120′ on each side of stream course. Moderate erosion hazard: 100′ on each side of stream course. Slight erosion hazard: 70′ on each side of stream course. **Nonriparian stream course**: Severe erosion hazard: 100′ on each side of stream course. Moderate erosion hazard: 70′ on each side of stream course. Slight erosion hazard: 35′ on each side of stream course. Accepted harvest activities within riparian and nonriparian filter strips include mechanical and conventional tree felling and limited skidding on designated skid trails and not across stream courses. Landings, decking areas, machine piles, and roads (except at designated crossings) are planned outside of riparian and nonriparian filter strips.	X		Filter sediment and/or providing bank stability on all stream courses and to minimize impacts on severe erosion soils. To implement the Oak Creek E. Coli TMDL and Lake Mary Region Mercury TMDL and to filter sediment and/or provide bank stability.
SW33	Manage for 5–7 tons of CWD per acre in ponderosa pine.	X		Promote long term soil productivity.
SW34	Mechanical crushing of lopped slash can only occur on 0–25 percent slopes.	X		Incorporate slash into the soil to promote long term soil productivity.

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SW35	Identify landings, staging area for heavy equipment, and sites for any in-woods processing sites outside of filter strips and meadows. Sites would be rehabilitated after use by methods such as, but not limited to: (1) ripping to remove compaction, (2) seeding with certified weed-free native seed to 5 pounds per acre. Potential vegetation for individual sites should utilize the Kaibab and Coconino NFs' TES to identify species to be utilized, and (3) spreading of slash to disguise the site and provide for a mulch for seeds.	X		Minimize and mitigate impacts from activities that compact sites, restore long term soil productivity, and minimize impacts on severe erosion soils.
SW36	The TSC outlines the timing and application of erosion control methods in BT6.31, BT6.6, BT6.63, BT6.64, BT6.65, CT6.6, CT6.601, and CT6.602 to minimize soil loss and sedimentation of stream courses. Seed mix can include any of the following certified weed-free native species at a minimum of 5 pounds per acre pure live seed: • Arizona fescue (*Festuca arizonica*) • Screwleaf muhly (*Muhlenbergia virescens*) • Western wheatgrass (*Elymus smithii*) • Mountain muhly (*Muhlenbergia montana*) • Purple geranium (*Geranium caespitosum*) • Western yarrow (*Achillea millefollium*) • Pussytoes (*Antennaria marginata*) • Arizona peavine (*Lathyrus arizonicus*) • Fringed sagebrush (*Artemisia frigida*) The seed mix can contain a mixture of all or some of these suggested species, but should not contain all of these species and should include at least one grass species. The seed mix depends on the availability of these species. Corresponding BMPs to minimize soil loss and sedimentation of streamcourses include 24.13, 24.21, 24.22, 24.23, 24.24, and			Minimize soil loss and sedimentation of stream courses from skidding operations. Minimize noxious weed spread and reestablish native vegetation.

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	24.25. Erosion control on the skid trails in the harvest areas would be by spreading slash. Other acceptable erosion control measures include, but are not limited to, waterbarring (waterbars should not be more than 2′ deep and need at least a 10′ leadout). Waterbars are only to be implemented with equipment with an articulating blade (no skidders) or by hand. Erosion control after skidding operations must be timely to minimize the effects of log skidding.			
SW37	For spring restoration actions, no decking or piling of material within 100′ of spring source or outflow would occur. Protect Bebb’s willow from prescribed burn (if it occurs). Design any fencing to minimize impacts to wildlife (including avian species) and provide bats and other desirable wildlife passage; mitigate any cultural resource concerns through avoidance of sites; prevent the spread of noxious weeds through any management activities by prescribing equipment cleaning; prevent chytrid fungus spread at spring sites by prescribing chytrid prevention methodologies. Work with landscape architect to design structures that reduce impacts to scenic quality. See W42, W43, W46, and W47 for additional fence mitigation.	X	X	Minimize and mitigate impacts from activities.
Transportation				
T1	Utilize accepted engineering practices and manual direction for maintenance and reconstruction practices.	X		Maintain a safe and economic road system.
T2	Coordinate any road use in association with the El Paso and Transwestern High-Pressure Natural Gas pipelines. Hauling can occur at designated crossings with sufficient pad material. No hauling is proposed down these gas pipelines on Forest Roads 160, 796, 6796, 09007P, 09008P, 09228D, 09229Y, and 09231Q.		X	Prevent damage to high-pressure gas pipelines.
T3	On areas to be prescribed burned, if decommissioned roads are to be used as fire lines, return decommissioned roads to that condition post-burning. Rehabilitation of the surface should refer			Discourage use on previously decommissioned roads and maintain a safe and economic road system.

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	to the soil and water BMPs for rehabilitation of fire lines and disturbed areas.			
T4	Utilize road safety signage with any project road activities that are related to project implementation.			Provide for user safety.
T5	See SW22			
T6	Utilize the closest material source that has the specified material type for all road maintenance/reconstruction/relocation to projects.			Minimize energy use for road maintenance/reconstruction/relocation activities.
T7	Road maintenance through the timber sale contract or stewardship contract should require pre-haul and post-haul maintenance on all roads to be used for haul.			Provide for a safe travel surface and provide for access to the project area.
T8	Utilize mitigation measures for soil and water, recreation, cultural resources, timber/silviculture, wildlife and botany/noxious weeds in project design to minimize resource impacts from the transportation system. Work with landscape architect to design structures that reduce impacts to scenic quality.			Minimize resource impacts from the transportation system.
Wildlife				
W1	Bald eagle winter concentration areas, retain the tallest snags >18″ d.b.h.	X		Bald eagle winter concentration areas.
W2	No vegetation treatments would occur within a buffer up to ½ mile (2,500 ft.), unless mitigated by topography, of an occupied bald or golden eagle nest between March 1 and August 31 (there are 3 bald eagle nests and 19 golden eagle nests within a ½ mile of the project analysis area). Other project activities will be assessed by the district biologist and limited activities may be acceptable.	X		Bald or golden eagle nests.

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W3	No mechanical treatments would occur within a 300′ radius of bald eagle nest trees (there are three bald eagle nests within 300′ of the project boundary).	X		Bald eagle nest trees.
W4	No project activities would occur within 500′ of confirmed bald eagle communal roosts from October 15–April 15. There are currently 19 confirmed roosts in the project area.	X		Bald eagle communal roost sites.
W5	Raptor nests located during project surveys would be monitored prior to project activities. Known nest trees for any raptor species would be prepped prior to prescribed burning. Buffers will be provided if nests are active.	X		Raptor nests.
W6	Burn plans within subunits 1-1, 1-3, 3-5, and 5-2 would be coordinated with the district wildlife biologist to insure nesting eagles will not be adversely impacted from smoke.		X	Bald and gold eagle nest sites.
W7	Forest plan direction would be followed for buffers surrounding raptor nests. Currently, that includes a no mechanical treatment buffer of 10 acres around occupied sharp-shinned hawk nests.	X		Sharp-shinned hawk nests.
W8	Forest plan direction would be followed for buffers surrounding raptor nests. Currently, that includes a no mechanical treatment buffer of 15 acres around occupied Cooper’s hawk nests.	X		Cooper’s hawk.
W9	Forest plan direction would be followed for buffers surrounding raptor nests. Currently, that includes a no mechanical treatment buffer of 20 acres around osprey nest sites (occupied or unoccupied). Use site specific analysis to determine no-treatment zone around nest site and all logging activities will be restricted within ¼ mile of active nests from March 1–August 15.	X		Osprey.
W10	Forest plan direction would be followed for buffers surrounding raptor nests. Currently, that includes a 50′ no-treatment buffer around other occupied raptors nests.	X		Other raptors.

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W11	Great blue herons – no dominant or codominant trees would be cut in rookeries. Known sites would be prepped prior to prescribed burning, fire can enter roosts but do not ignite within roost stands. Timing would avoid mechanical tree harvest while birds are in the nest. Activities will be coordinated with the local biologist.	X		Great blue heron.
W12	See appendix D, sections A-B, for MSO habitat design features.	X		
W13	MSO surveys in the project area the year of implementation or 1 year prior to determine if new areas are occupied by owls.	X		MSO restricted and protected habitat.
W14	Pre- and post-treatment habitat monitoring would occur as specified in the MSO recovery plan.	X		MSO restricted and protected habitat.
W15	Spring restoration inside PACs would not occur during the breeding season (March 1–August 31) if occupied in Rocktop, Sawmill Spring, Red Raspberry, and Weimer Spring PACs (i.e., 4 out of 78 proposed spring restoration sites).	X		MSO protected activity centers.
W16	Ephemeral stream restoration would not occur inside PACs during the breeding season (March 1–August 31) if occupied in Bear Seep, Clark, Holdup, Coulter Ridge, and Meadow Tank MSO PACs.	X		MSO protected activity centers.
W17	Road construction, obliteration, relocation, and maintenance would not occur inside PACs during the breeding season (March 1–August 31) if occupied.	X		MSO protected activity centers.
W18	No treatments would occur in PACs within a ¼ mile of core area (potentially adjusted by topography) during the breeding season (March 1–August 31) if occupied.	X		MSO protected activity centers.
W19	Hauling would not occur within PACs during the breeding season (March 1–August 31) except where specific analysis has documented that impacts would not lead to adverse effects.	X		MSO protected activity centers.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
W20	No new wire fencing would be constructed in PACs. Other alternatives would be used for aspen, seep, spring, and ephemeral drainage restoration exclosures. Alternatives would be coordinated with other specialists. If suitable alternatives cannot be identified, restoration work would be postponed.		X	MSO protected activity centers.
W21	Coordinate burning spatially and temporally to limit smoke impacts to nesting owls, particularly for PACs with nests in draws and canyons (effective March 1–August 31).	X		MSO protected activity centers.
W22	Fire line associated with preventing fire from entering PACs and/or core areas would be constructed outside the nesting season (alternatives B and C).		X	MSO protected activity centers.
W23	Implementation would be phased in across the landscape so that not all MSO Habitat would be treated in 1 year.	X		MSO habitat.
W24	Prescribed burn plans would be designed and implemented to minimize smoke impacts to nesting birds and minimize loss of nest trees.	X		Goshawk nest stands.
W25	Not all harvest activities would occur in occupied PFAs during the breeding season. However, work could potentially occur on a case-by-case basis through coordination with the district biologist if pre-treatment surveys determine they are not occupied.	X		Goshawk PFAs.
W26	Spring and ephemeral drainage restoration projects would not occur in the Barney Spring, Tree Spring, Schultz Pass, Squaw, Marteen, Coxcombs, Pumphouse, Walnut, Faye, Marshall Mesa, Newman, Cherry Canyon, and Monument 36 PFAs during the breeding season (March 1–September 30) if occupied. However, work could potentially occur on a case-by-case basis through coordination with the district biologist if pre-treatment surveys have determined they are not occupied or impacts will not affect nesting birds.	X		Goshawk PFAs.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
W27	Logging trucks would not exceed 25 m.p.h. when traveling through PFAs during the nesting season (March 1–September 30).		X	Goshawk PFAs.
W28	Road construction, obliteration, relocation, and maintenance would not occur inside PFAs during the breeding season (March 1– September 30) if occupied.		X	Goshawk PFAs.
W29	Because of declining trends in populations, defer logging activities between May 15 and August 31 in fawning habitat as identified by the ADGF.	X		Deer habitat.
W30	Avoid thinning and burning within the known pronghorn travelway on the Williams RD during the first major snowfall of a given year to allow for seasonal migration.		X	Pronghorn habitat.
W31	Do not create interspaces and openings where hiding cover exists near dependable waters identified by the ADGF (e.g., stock tanks, lakes, and riparian stream reaches) and through implementation of watershed BMPs.		X	General.
W32	Protect snags and logs wherever possible through site prep, implementation planning, and ignition techniques to retain snags >18″ d.b.h. and ≥ three logs with >12″ mid-point diameter. Do not directly ignite snags. In general, manage for 5 to 7 tons of CWD and at least three logs per acre except in areas with identified WUI treatments.	X		General.
W33	Protect snags and logs wherever possible by placing landings in existing openings or in areas where snags and/or logs and old trees would be minimally impacted.		X	General.
W34	Retain trees with dead tops, cavities, and lightning strikes wherever possible to provide cavity nesting/foraging habitat (i.e., the living dead).		X	General.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
W35	Emphasize retention of snags exhibiting loose bark to provide habitat for roosting bats.		X	Bat habitat.
W36	No thinning or direct ignition within ¼-mile distance from tanks or designated along logical topographic breaks. (See the wildlife report for a list of location/sites within ¼-mile buffers). The district wildlife biologist may work with implementation teams to determine the habitat protection buffer boundary.	X		Northern leopard frog designated occupied/ critical breeding sites (six sites).
W37	Seasonal restrictions (April 15–September 15) for all proposed activities would be implemented within a 200′ buffer (or along logical topographic breaks) at all designated important water sites (i.e., 10 sites in RU 1) (see wildlife report for a list of locations and sites). The district wildlife biologist may work with implementation teams to determine the habitat protection buffer boundary.	X		Northern leopard frog potential breeding sites.
W38	In subunits 1-2, 1-4, 1-5, and 1-6, a 200′ protection zone (100′ either side of the stream) would be established around designated stream courses (see northern leopard frog travel linkage zone in within subunits 1-2, 1-4 and 1-5 in wildlife report for more details). There would be no thinning and no direct ignition of prescribed burning within the protection zones. Designated skid trail crossings through the buffer zone are allowed. Fall burning and burn plans should be coordinated with district wildlife biologists.	X		Northern leopard frog dispersal habitat.
W39	Mechanized equipment would avoid wetted soils in northern leopard frog habitat unless decontamination practices for Chytrid are employed first.		X	Northern leopard frog designated, potential, and dispersal habitat.
W40	A 300′ no mechanical treatment buffer would be designated around cave entrances and sink hole rims (i.e., karst) to protect cave ecosystems from siltation, protect human health and safety, and reduce potential disturbance to roosting bats. Existing roads	X		Protect bat habitat: caves, karst, and sink holes.

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
	could be used for mechanical harvest but no new skid trails would be created. The intent is to avoid changing the cave/karst microclimate, (including altering vegetation near the inside and outside of the entrance/rim) and hydrology while reducing surface fuels. Ignition and other prescribed fire techniques would maintain existing vegetation patterns and forest plan guidance for snags and logs while reducing fuel loads and protecting cave and karst ecosystems from post-treatment sediment deposition.			
W41	Prairie dog surveys would be completed prior to mechanical treatment in documented prairie dog towns within treatment areas to determine if towns are active. If active towns form a large enough complex to support ferrets, black-footed ferret surveys would be completed prior to implementation within prairie dog towns. Coordinate with local biologists.	ESA		Black footed ferret; prairie dog towns.
W42	Attach bird flight diverters (as provided by ADGF) to exclosure fencing around springs, channels, and aspen stands to avoid wildlife collisions.		X	General.
W43	Avoid fence (i.e., exclosure) construction in PACs and PFAs during the respective breeding seasons (March 1–August 31 and March 1–September 30).		X	General.
W44	All stands included in the proposed mechanical treatments for 18 MSO PACs would be marked for harvest by hand and marking would be coordinated with the FWS.		X	
W45	In MSO restricted and protected habitat, trees greater than 24” would not be cut.	X		

Design Criteria No.	Description	Purpose: Forest Plan Compliance	Purpose: Specialist Recommen-dation	Comment or Purpose
W46	Fences should be designed, modified, or removed to minimize impacts on wildlife movement. For example, road right-of-way fences should be located 1/8 mile from roads, and lay-down fences, etc., should be designed to minimize restriction to pronghorn movement.		X	Provides consistency with draft Coconino NF forest plan.
W47	Construction of additional fences should be minimal. Fence maintenance should be prioritized in threatened, endangered, and sensitive species habitat and important movement corridors, and should occur as needed. Fences that are no longer needed should be removed.		X	Provides consistency with draft Coconino NF forest plan.
W48	"Snags would be managed for at least two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for at least three per acre ≥12 inches."		X	Provides consistency forest plans.
W49	Contractors will be advised of the possibility of California condors in the project area. Should a condor land near project activities, contractors will be instructed not to haze condors.	X		The mitigation measures (W-51 to W-55) for condor were developed and recommended by the Arizona condor working group. Although not specifically written as presented, the measures meet the intent in the Coconino and Kaibab NFs forest plans of recovering listed species.
W50	All contractors would be instructed to avoid interacting with condors and to immediately contact the appropriate FS personnel if occurs in the project area. Sighting locations will be forwarded to the Peregrine Fund and the FWS.	X		
W51	Any project activity that may cause imminent harm to condors will temporarily cease until permitted personnel determine the correct course of action.	X		

Design Criteria No.	Description	Purpose		Comment or Purpose
		Forest Plan Compliance	Specialist Recommen-dation	
W52	Project-related work areas will be kept clean (e.g., trash disposed of, scrap materials picked-up, etc.) in order to minimize the possibility of condors accessing inappropriate materials. The FS will complete site visits to ensure cleanup is adequate.	X		
W53	A hazardous material spill plan will be developed and implemented with details on how each hazardous substance will be treated in case of leaks or spills.	X		
W54	Pesticide use will follow the guidelines for California condors as described in the April 2007 Recommended Protection Measures for Pesticide Applications in Region 2 of the FWS.	X		

Appendix D – Alternative B Through D Implementation Plan

The environmental impact statement (EIS) describes the purpose and need, alternatives and the effects of managing the 4FRI project area. This implementation plan is designed to be integral to the selected alternative and record of decision (ROD). The process described in this appendix describes the linkage from the EIS to the project specific work without the need for additional NEPA analysis. It must be considered in conjunction with appendix C that provides the design criteria, best management practices, and mitigation measures. Table 112 to table 115 are checklists designed to ensure compliance with the analysis, decision, and other requirements. Essentially, if the quantity of treatments in table 112 and table 113 by resource unit are within the bounds of the treatments analyzed in chapter 3 of the EIS and the specialist's reports, then the program of work is considered to be consistent with the effects analysis.

Table 114 and table 115 show the compliance evaluation and documentation requirements to also demonstrate this compliance. Sections A through E provide direction that would be used by implementation personnel to ensure that implementation meets the purpose and need and forest plan standards and guidelines. It is the foundation for the formal silvicultural prescriptions. The silvicultural prescriptions will document the desired conditions presented in the analysis, incorporate design features and mitigation (appendix C), and provide the course of action needed to move toward those desired conditions.

Description of Plan Components

Table 112: Annual Implementation Checklist. The checklist is designed to track compliance with the NEPA decision and ensure activities are consistent and compliant with the analysis and decision (correct location, appropriate number of acres by treatment type). The checklist is designed to be used by the implementation team leader. Sources of data to populate row three are found in chapter 3 and the specialists reports.

Table 113: Planned Acres by Treatment Type and Restoration Unit (RU). The checklist is designed to facilitate accomplishment reporting. The checklist is designed to be used (at a minimum) by the implementation team leader and forest program managers. Sources of data to populate row three are found in chapter 3 and the specialists reports.

Table 114: NEPA, NFMA, ESA, CFLR Act Compliance Evaluation. The checklist is designed to ensure resource surveys are completed as required by the forest plan, policy, U.S. Fish and Wildlife Service (FWS) biological opinion, Comprehensive Forest Landscape Restoration Act (CFLR), or other requirements. The checklist also ensures that the site-specific treatments are compliant with the NEPA analysis and decision. The checklist is designed to be used by the resource specialists who comprise the implementation team and by the Agency's (delegated) approving official.

Table 115: Supporting Documentation. This checklist is designed to ensure required plans and surveys are tracked annually and are readily accessible to the implementation team and approving official. It will be used in combination with appendix E that shows the adaptive management strategy.

Section A: This section includes existing forest plan management direction, desired conditions, and treatment specific silvicultural design. It is designed to be used by the project silviculturist and implementation team.

Section B: Section B is a decision matrix to be used by the project silviculturist and implementation team to facilitate establishing tree groups, interspace, and regeneration openings as appropriate for each individual treatment.

Section C: This section provides old tree descriptions, illustrations, and guidance used to implement the old tree implementation plan.

Section D: Section D includes guidance and the "Modified Large Tree Implementation Plan". The guidance is designed to be reviewed by the project's silviculturist during development of prescriptions and during implementation. **Section D only applies to alternative C.**

Section E: Section E describes the relationship between treatment intensity, tree group density, and overall average density. It includes density management and stocking guidelines. It is designed to be used by the project silviculturist (in the design of prescriptions) and implementation team.

Table 112. Annual implementation checklist

Implementation Checklist	Details				
Project name:					
Project location (legal):					
Summary of activities proposed in this phase:					
Is the project located within the project boundary displayed in the FEIS/ROD?					
Identify the restoration unit (RU) in which the project phase is located based on the FEIS/ROD.	**RU1**	**RU3**	**RU4**	**RU5**	**RU6**
(1) How many acres have been treated by RU since the ROD was signed?					
(2) How many remaining acres are available for treatment by RU over the lifetime of the decision? (1–2)					
(3) How total many acres will this project (or task order) treat by RU?					
(4) Are the acres to be treated by RU less than remaining acres available for treatment? (3–4)					
Are acres proposed for treatment by RU within the limits approved by the decision?	**Yes**_____________ **No**_______________				

Table 113. Planned acres by treatment type and restoration unit (RU)

Acre/Miles by Treatment Type to be Implemented in this Phase	RU1	RU3	RU4	RU5	RU6
Aspen					
Prescribed Fire Only					
ADGF Research					
Grassland Restoration					
Grassland Mechanical					
Intermediate Thin (IT) 10 (10 to 25% interspace)					
Intermediate Thin (IT) 25 (25 to 40% interspace)					
Intermediate Thin (IT) 40 (40 to 55% interspace)					
MSO Threshold					
MSO Target					
MSO Restricted					
MSO PAC					
MSO PAC Grassland Mechanical					
Pine-sage					

Acre/Miles by Treatment Type to be Implemented in this Phase	RU1	RU3	RU4	RU5	RU6
Savanna (70 to 90% interspace)					
Stand Improvement (SI) 10 (10 to 25% interspace)					
Stand Improvement (SI) 25 (25 to 40% interspace)					
Stand Improvement (SI) 40 (40 to 55% interspace)					
Uneven-aged (UEA) 10 (10 to 25% interspace)					
Uneven-aged (UEA) 25 (25 to 40% interspace)					
Uneven-aged (UEA) 40 (40 to 55% interspace)					
Wildland-Urban Interface (WUI) Pinyon-juniper					
Wildland-Urban Interface (WUI) 55					
Pile Burning					
Broadcast Burning					
Jackpot Burning					
Fire Line Construction					

Acre/Miles by Treatment Type to be Implemented in this Phase		RU1	RU3	RU4	RU5	RU6
Existing System and Unauthorized Road Decommission						
Temporary Road Construction						
Temporary Road Decommission						
Road Reconstruction/Relocation						
Springs	Remove Trees to Pre-settlement Condition					
	Remove Noxious Weeds					
	Prescribed Fire					
	Protective Measures					
Ephemeral Channels	Reestablish Drainage, Slopes, Vegetation					
	Site Protection					
	Remove or Rehab Stock Tanks					
	Other					
Construct Protective Fencing: Springs/Aspen						
Are acres proposed for treatments in this phase within the limits authorized in the decision?		**Yes**_____________ **No**_______________				

Table 114. NEPA, NFMA, ESA, CFLR Act compliance evaluation

Compliance Evaluation	Yes	No	Not Applicable
Is the project within the maximum treatment acres identified in the NEPA decision?			
Is treatment design consistent with desired conditions, design criteria, and mitigation?			
Are wildlife and botanical surveys, if necessary, complete? Is the action consistent with the FWS biological opinion dated__________?			
Are heritage surveys complete? Is the action consistent with the letter of concurrence form the AZ SHPO dated________?			
Have contacts with tribal representatives been made?			
Are rights-of-way and land line locations in place (if applicable)?			
Are treatments consistent with the Old Tree Implementation Plan (Section C)			
Has the monitoring and adaptive management plan been evaluated to document compliance with law, regulation, policy, and forest plans?			
Have additional implementation and effectiveness monitoring needs been identified?			
As required by CFLR Act, is multiparty monitoring underway?			
Are adaptive management actions being proposed? If so, clearly analyzed and covered by the decision made?			
Has the administrator checklist been completed and signed by the appropriate resource specialists?			
Is the treatment (burn) plan completed and signed? • Objectives have been developed in interdisciplinary manner and are clearly delineated? • Objectives are consistent with management direction? • Objectives match those described for RU in NEPA analysis? Complexity rating______			
Do conditions match those described in NEPA analysis? Examples where conditions have changed: New listed species in project area; New invasive species in project area; Change in regulations Burn/treatment plan doesn't allow implementing design criteria	YES___ ___	NO____ ___	
Have issues identified in the NEPA analysis been reviewed?			
Has a post-implementation review been completed (may be filled out after approval)?			
Alternative C Only: Are treatments consistent with Large Tree Implementation Plan? (Section D)			

Table 115. Supporting documentation checklist

Document Name	Attached? Y/N
Silviculture Prescriptions	
Burn Plan	
Transportation Safety Plan	
Wildlife Surveys	
Botany Surveys	
Archaeological Surveys	
Monitoring Results	

Project Resource Specialist Review

Based on my review, the project is consistent with the Coconino and Kaibab National Forests final environmental impact statement and record of decision (FEIS/ROD) implementing the Coconino and Kaibab NFs restoration project.

Name/Signature	Date	Resource Area
		Terrestrial and Aquatic Wildlife
		Botany
		Range
		Recreation
		Scenery
		Archaeology and Tribal Relations
		Fire
		Air Quality/Smoke
		Lands
		Soils and Hydrology
		Silviculture
		Planning/NEPA
		Transportation
		Public Affairs

Approving Official

I have reviewed the activities proposed for this year. Based on my review, the project is consistent with the Coconino and Kaibab National Forests final environmental impact statement and record of decision implementing the Coconino and Kaibab NFs restoration project.

____ ____________________

Agency Approving Official, Title **Date**

ATTACHMENTS: (add to as necessary)

Section A – Management Direction, Desired Conditions, and Treatment Design

MSO Habitat

Protected Activity Center (PAC)

Vegetation Management Direction: Retain key forest species such as oak; retain key habitat components such as snags and large down logs; harvest conifers less than 9 inches in diameter only within those PACs treated to abate fire risk and avoid treatment in 100-acre nest cores as described in the MSO recovery plan. Further 4FRI guidelines include the primary objective of improving MSO habitat when mechanically treating PACs potentially cutting trees greater than 9-inch d.b.h.

Desired Conditions: Table III.B.1 (USDI 1995) lists guidance for minimum desired structural elements within PACs. This includes 150 square feet of basal area (BA), 30 percent or more of the SDI in ponderosa pine trees ≥18-inch d.b.h., 15 percent or more of the stand density index in ponderosa pine trees between 12- and 18-inch d.b.h., ≥20 trees per acre ≥18-inch d.b.h., and ≥20 Gambel oak BA. Other key habitat components includes snags 18 inches plus, down logs >12-inch midpoint diameter, hardwoods, and an understory vegetation layer that includes shrubs and herbaceous species.

PAC Mechanical Thin and Burn Treatment Design

Each PAC has 100-acre no treatment area around the known nest or roost sites.

Outside the 100-acre no treatment area, trees may be thinned and/or prescribed burns may be used to treat fuels and mitigate fuel hazards where feasible.

Each PAC to be thinned would have an upper diameter limit of trees that may be cut. All trees above that limit would be retained.

Intermediate thinning would be used to increase residual tree health and vigor and reduce fire hazard.

Manage for 150 square feet of BA where present or to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density in alternatives B and D. In alternative C, manage for a minimum of 110 square feet of BA where present or to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density.

Manage for irregular tree spacing to create canopy gaps and other structural conditions that would be conducive to low intensity prescribed fire treatment.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation strategy by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to the treatment diameter limit that do not meet the old tree definition and whose crowns are outside the old tree crown drip line (1) within a 50-foot radius that are in the intermediate or suppressed crown positions and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch diameter at root collar (drc) or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species will not be cut as part of the treatments. These species may only be cut when there is no other option to facilitate logging operations (skid trails and landings).

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height and reducing litter/duff cover and other surface fuel loading. Prescribed fires are designed to maintain and enhance desired MSO PAC habitat forest structure, tree densities, snag densities, and CWD levels.

PAC Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height and reduce litter/duff cover and other surface fuel loading.

Prescribed fires are designed to maintain and enhance desired MSO PAC habitat forest structure, tree densities, snag densities, and CWD levels.

Steep Slopes

Vegetation Management Direction: Treat fuel accumulations to abate fire risk. Use combinations of thinning trees less than 9 inches in diameter, mechanical fuel removal, and prescribed fire; retain woody debris larger than 12 inches in diameter, snags, clumps of broad-leafed woody vegetation, and hardwood trees larger than 10-inch drc.

Desired Conditions: Table III.B.1 (USDI 1995) lists structural elements. Other key habitat components includes snags 18 inches plus, down logs >12-inch midpoint diameter, hardwoods, and an understory vegetation layer that includes shrubs and herbaceous species.

Steep Slopes Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height and reduce litter/duff cover and other surface fuel loading.

Prescribed fires are designed to maintain and enhance desired MSO protected forest structure, tree densities, snag densities, and CWD levels.

Restricted Habitat (Table 116)

Definition: Pine-oak – ponderosa pine habitat type series; within the Gambel oak or Gambel oak phase of the habitat type; ≥10 percent of the stand BA or 10 square feet per acre of BA consists of Gambel oak ≥5 inches drc.

General Vegetation Management Direction: Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Habitat variables are documented in table III.B.1 of the MSO recovery plan (USDI 2012). Management would attempt to mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes. Allow natural canopy gap processes to occur, thus producing horizontal variation in stand structure. Emphasize uneven-aged management systems. Both even-aged and uneven-aged systems may be used where appropriate to provide variation in existing stand structure and species diversity. Save all trees greater than 24-inch d.b.h. Retain existing large oaks and promote growth of additional large oaks. Encourage prescribed fire to reduce hazardous fuel accumulation. Retain substantive amounts of key habitat components (snags 18 inches plus, down logs >12-inch midpoint diameter, and hardwoods).

Table 116. MSO restricted habitat target/threshold conditions for pine-oak forests

Stand Averages	
BA	≥150 BA
18-inch + trees/acre (TPA)	≥20
Oak BA (square feet)	≥20 BA
Percent Total Existing SDI by Size Class	
12–18″	≥15
18–24″	≥15
24+″	≥15

Threshold Habitat

Vegetation Management Direction: Stand averages currently meet or exceed threshold values in table III.B.1 of the MSO recovery plan. Management would not reduce variables below the threshold values.

Desired Conditions: Irregular tree spacing and various patch size. Horizontal variation in stand structure. Other key habitat components includes snags 18 inches plus, down logs >12-inch midpoint diameter, and hardwoods.

Threshold Mechanical Thin and Burn Treatment Design

Intermediate thinning would be used to increase residual tree health and vigor and reduce fire hazard.

Manage for ≥150 square feet of BA where present, with a portion of those acres ≥170 square feet of BA in alternatives B and D. In alternative C, manage for a minimum 110 square feet of BA and manage for ≥ 150 square feet of BA where present in areas with site potential capable of sustaining high tree density.

Manage to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density in all alternatives.

Manage for irregular tree spacing to create canopy gaps and other structural conditions that would be conducive to low intensity prescribed fire treatment.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation strategy by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18-inch d.b.h. that do not meet the old tree definition and whose crowns are outside the old tree crown drip line (1) within a 50-foot radius that are in the intermediate or suppressed crown positions and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

No trees larger than 24-inch d.b.h. would be cut.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch drc or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species will not be cut as part of the treatments. These species may only be cut when there is no other option to facilitate logging operations (skid trails and landings).

Snags would be managed for two per acre ≥18 inches and at least 30 feet in height, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches and a minimum of 8 feet in length.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height and reducing litter/duff cover and other surface fuel loading. Prescribed fires are designed to maintain and enhance desired MSO restricted threshold habitat forest structure, tree densities, snag densities, and CWD levels.

Threshold Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height and reduce litter/duff cover and other surface fuel loading.

Prescribed fires are designed to maintain and enhance desired MSO restricted threshold habitat forest structure, tree densities, snag densities, and CWD levels.

Target

Vegetation Management Direction: Stand averages currently meet or exceed some threshold values in table III.B.1 of the MSO recovery plan. Management would not reduce variables that are currently at or above the threshold value below the threshold values. Management would encourage development of threshold values that are lacking.

Desired Conditions: Irregular tree spacing and various patch size. Horizontal variation in stand structure. Other key habitat components include snags 18 inches plus, down logs greater than 12 inches midpoint diameter, and hardwoods.

Target Mechanical Thin and Burn Treatment Design

Intermediate thinning would be used to increase residual tree health and vigor and reduce fire hazard.

Manage for 150 square feet of BA where present or to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density in alternatives B and D. In alternative C, manage for a minimum 110 square feet and manage for ≥ 150 square feet of BA where present in areas with site potential capable of sustaining high tree density.

Manage for irregular tree spacing to create canopy gaps and other structural conditions that would be conducive to low intensity prescribed fire treatment.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation strategy by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition and whose crowns are outside the old tree crown drip line: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

No trees larger than 24-inch d.b.h. would be cut.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c. or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species will not be cut as part of the treatments. These species may only be cut when there is no other option to facilitate logging operations (skid trails and landings).

Snags would be managed for two per acre ≥18 inches and at least 30 feet in height, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches and a minimum of 8 feet in length.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height and reducing litter/duff cover and other surface fuel loading.

Prescribed fires are designed to maintain and enhance desired MSO restricted target habitat forest structure, tree densities, snag densities, and CWD levels.

Target Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height and reduce litter/duff cover and other surface fuel loading.

Prescribed fires are designed to maintain and enhance desired MSO restricted target habitat forest structure, tree densities, snag densities, and CWD levels.

Restricted Other (Table 117)

Vegetation Management Direction: Current stand averages meet few of the threshold values in table III.B.1 of the MSO recovery plan (USDI 2012). Management would encourage development of threshold values that are lacking.

Desired Conditions: Uneven aged (3-plus age classes). Irregular tree spacing and various patch size. Horizontal variation in stand structure. Other key habitat components includes snags 18 inches plus, down logs >12-inch midpoint diameter, and hardwoods.

Restricted Other Mechanical Thin and Burn Treatment Design

Uneven age thinning and group selection would be used to establish interspace between tree groups, thin tree groups, and create regeneration openings.

Treatments would strive to attain the following overall average density and structural characteristics described in table 117.

Table 117. Restricted other habitat treatment criteria

Stand Averages	
BA	70–90 ft²
Stand density index – % of max	25–40
18 inch + trees/acre (TPA)	≥20
Oak BA (square feet)	≥20+
Percent Total SDI by Size Class	
12–18”	≥15
18–24”	≥15
24+”	≥15

Manage for a range of density and structural characteristics by thinning areas with a southerly aspect to an overall average of 60 to 80 square feet of BA and areas with northerly aspect to an overall average of 80 to 100 square feet of BA. Density would vary within these ranges depending on existing stand structure.

Individual trees and tree groups would occupy approximately 60 to 75 percent of the area.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation strategy by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

No trees larger than 24-inch d.b.h. would be cut.

Tree groups, on average, would range in size from 0.1 to 1 acre with northerly aspects and highly productive microsites having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

Manage for tree groups with different age classes by retaining individual and clumps of vigorous ponderosa pine seedlings, sapling, and poles within larger mid-aged, mature, or old tree groups.

Trees within the dominate and codominant crown position would have priority for retention within groups. Where age class diversity is not present, 1 to 10 suppressed and intermediate trees per group would be retained for vertical diversity.

Interspace would occupy approximately 25 to 40 percent of the area.

Interspace width between tree groups would average from 25 to 60 feet with a maximum width of 200 feet.

Regeneration openings (group selection) account for 10 to 20 percent of tree groups. The percentage would vary within this range depending on current age class distribution. They would average 0.3 to 0.8 acre and would not exceed 200 feet wide. In general, regeneration openings would not be larger than 2 acres. However, they may extend up to 4 acres in specific areas where ponderosa pine mistletoe infections are heavy. They would only be established by removing groups of trees comprised of the most abundant tree size classes. Regeneration openings would be created adjacent to tree groups and would not be surrounded by interspace.

Manage moderate to heavy dwarf mistletoe infection centers that are not intended for regeneration openings for improved tree vigor and growth by retaining the best growing dominant and codominant trees with the least amount of mistletoe.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c. or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11-inch d.r.c. may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation s.trategy), and when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches and at least 30 feet in height, CWD would be managed for 5 to 7 tons per acre; downed logs would be managed for three per acre ≥12 inches and a minimum of 8 feet in length.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired MSO restricted other habitat forest structure, tree densities, snag densities, and CWD levels.

Restricted Other Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height, reduce litter/duff cover, and produce effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired MSO restricted other forest structure, tree densities, snag densities, and CWD levels.

Goshawk Habitat

General – Ponderosa Pine

Vegetation Management Direction: Manage for uneven-age stand conditions for live trees and retain live reserve trees, snags, downed logs, and woody debris levels throughout ponderosa pine forest cover types. Manage for old age trees such that as much old forest structure as possible is sustained over time across the landscape. Provide for or preserve existing clumps of trees with interlocking crowns. Sustain a mosaic of vegetation densities (overstory and understory), age classes, and species composition across the landscape. Encourage aspen and oak regeneration. Provide habitat for goshawk prey.

Desired Conditions: Highly interspersed, heterogeneous pattern and size of tree groups and interspace across the landscape. Tree groups are dominated by trees of a similar age and range from young to old (uneven aged). Interspace has a robust herbaceous layer.

Landscapes Outside of Goshawk Post-fledgling Areas (LOPFA) – Ponderosa Pine

Vegetation Management Direction: Distribution of vegetation structural stages for ponderosa pine – 10 percent grass/forb/shrub (VSS 1), 10 percent seedling-sapling (VSS 2), 20 percent young forest (VSS 3), 20 percent mid-aged forest (VSS 4), 20 percent mature forest (VSS 5), 20 percent old forest (VSS6). The distribution of VSS, tree density, and tree age are a product of site quality in the EMA. Use site quality to guide in the distribution of VSS, tree density, and tree ages. Snags are ≥18-inch d.b.h. and ≥30 feet in height, downed logs are 12 inches in diameter and are ≥8 feet long, woody debris is ≥3 inches on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape. Canopy cover guidelines apply only to mid-aged to old forest structural stages (VSS 4, VSS 5, and VSS 6). Further 4FRI direction is documented in the forest plan amendment that clarifies openness and clarifies that guidelines for canopy cover apply to mid-aged to old forest structural stage dominated tree groups across the LOPFA.

Desired Conditions: Uneven-aged with a balance of age classes. Within group structure specific to mid-aged to old classes (VSS 4 to 6) includes open understories, interlocking tree crowns, abundant large limbs, and shade.

LOPFA, WUI55, UEA40, UEA25 and UEA10 Mechanical Thin and Burn Treatments Design

Uneven-age thinning and group selection would be used to establish interspace between individual trees and tree groups, thin tree groups, and create regeneration openings within LOPFA sites with none to low dwarf mistletoe infections that are uneven age or even age with a quadratic mean diameter (QMD) ≥ 8.5 inches.

Treatments would strive to attain an overall average density of 50 to 70 square feet of BA and 15 to 35 percent of maximum SDI inclusive of groups, interspaces, and regeneration openings. Density would vary within this range depending on treatment intensity and existing stand structure. See section D for more detail on the relationship of overall density to interspace, tree groups, and regeneration openings.

Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as displayed in table 118.

Table 118. Percent of trees, tree groups, and interspaces by treatment intensity (LOPFA)

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree	Percent of Area Occupied by Interspace
WUI55	30–45	55–70
UEA40	45–60	40–55
UEA25	60–75	25–40
UEA10	75–90	10–25

Individual trees, tree groups, and interspaces would be managed to move toward a balance of age classes, both within and from tree group to tree group, by reducing the most abundant tree size classes and maintaining the underrepresented tree size classes.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation strategy by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

Tree groups, on average, would range in size from 0.1 to 1 acre with lower treatment intensities having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

Tree group density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for tree groups for the WUI55, UEA40, UEA25, and UEA10 mechanical thin treatments are as described in table 119.

Table 119. LOPFA WUI and UEA treatments stocking guidelines for tree groups

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
1 & 2 (20)	0–4.9	19	48	96	144	193	134–302	NA	NA
3 (20)	5–11.9	14	34	68	102	136	83–215	NA	NA
4 (20)	12–17.9	5	12	23	35	46	35–115	70–146	89–185
5 (20)	18–23.9	3	8	15	23	30	19–59	43–79	54–96
6 (20)	≥24	2	5	11	16	21	18–38	40–49	51–61

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2] Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class; the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Manage mid-aged, mature and old (VSS 4, 5, and 6) tree groups for a range of density and structural characteristics by thinning approximately 50 percent of the mid-aged, mature, and old tree groups to the lower density stocking, approximately 20 percent each to the middle density and upper density of desired stocking conditions as displayed in the stocking guideline table, and approximately 10 percent remain unthinned.

Manage for tree groups with different age classes by retaining individual and clumps of vigorous ponderosa pine seedlings, sapling, and poles within larger mid-aged, mature, or old tree groups.

Trees within the dominate and codominant crown position would have priority for retention within groups. Where age class diversity is not present, 1 to 10 suppressed and intermediate trees per group would be retained for vertical diversity.

Interspace width between tree groups would average from 25 to 120 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as described in table 120.

Table 120. Interspace percent and width in LOPFA WUI and UEA treatments

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
WUI55	55–70	80–120
UEA40	40–55	60–100
UEA25	25–40	40–60
UEA10	10–25	25–40

Regeneration openings (group selection) account for 10 to 20 percent of tree groups. The percentage would vary within this range depending on current VSS distribution. They would average 0.3 to 0.8 acre and would be no larger than 4 acres or 200 feet wide. They would only be established by removing groups of trees comprised of the most abundant tree size classes. Regeneration openings would be created adjacent to tree groups and would not be surrounded by interspace.

One group of reserve trees, three to five trees per group, would be left in created regeneration openings greater than an acre in size.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c. or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11-inch d.r.c. may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation strategy), and when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired LOPFA UEA forest structure, tree densities, snag densities, and CWD levels.

LOPFA UEA – ADGF Design Mechanical Thin and Burn (Alternative C) Design

Same as LOPFA UEA 10 with the exception of group size. Tree group size is dependent on experimental design and would range in size from 1 to 15 acres.

LOPFA Intermediate Thin (IT) 40, 25, and 10 Mechanical Thin and Burn Treatments Design

Intermediate thinning (IT) would be used to establish interspace between individual trees and tree groups and thin tree groups within LOPFA sites with moderate to high dwarf mistletoe infection that are uneven age or even age with a QMD ≥ 8.5 inches.

Treatments would strive to attain an overall average density of 70 to 90 square feet of BA and 25 to 40 percent of maximum SDI inclusive of groups and interspaces. Density would vary within these ranges depending on treatment intensity and existing stand structure. See section D for more detail on the relationship of overall density to interspace and tree groups.

Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as described in table 121.

Table 121. Percent of area occupied by trees, tree groups, and interspace in LOPFA IT

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
IT40	45–60	40–55
IT25	60–75	25–40
IT10	75–90	10–25

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy, and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation strategy by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

Tree groups, on average, would range in size from 0.1 to 1 acre with lower treatment intensities having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

Tree groups would be managed to improve tree vigor and growth by retaining the best growing dominant and codominant trees with the least amount of mistletoe within each group.

Tree group density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for VSS 4, 5, and 6 tree groups for the IT40, IT25, and IT10 mechanical thin treatments as described in table 122.

Table 122. Stocking guidelines for VSS 4 to 6 tree groups in LOPFA IT treatments

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
4 (20)	12–17.9	5	12	23	35	46	35–115	70–146	89–185
5 (20)	18–23.9	3	8	15	23	30	19–59	43–79	54–96
6 (20)	≥24	2	5	11	16	21	18–38	40–49	51–61

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2]Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Interspace width between tree groups would average from 25 to 80 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as described in table 123.

Table 123. Percent and width of interspace in LOPFA IT treatments

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
IT40	40–55	60–80
IT25	25–40	40–60
IT10	10–25	25–40

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c. or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11-inch d.r.c. may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation strategy), and when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired LOPFA IT forest structure, tree densities, snag densities, and CWD levels.

LOPFA Stand Improvement (SI) 40, 25, and 10 Mechanical Thin and Burn Treatments Design

Stand improvement thinning would be used to establish interspace between individual trees and tree groups, and thin tree groups within LOPFA sites with none to low dwarf mistletoe infection and are even-age sites with a QMD ≤ 8.5 inches.

Treatments would strive to attain an overall stand average density of 20 to 25 percent of maximum SDI inclusive of groups and interspaces. Density would vary within this range depending on treatment intensity and existing stand structure. See section D for more detail on the relationship of overall density to interspace and tree groups.

Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as described in table 124.

Table 124. Percent of area occupied by individual trees, tree groups, and interspace in LOPFA SI treatments

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
SI40	45–60	40–55
SI25	60–75	25–40
SI10	75–90	10–25

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy, and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation strategy by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

Tree groups, on average, would range in size from 0.1 to 1 acre with lower treatment intensities having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

Tree groups would be managed to improve tree vigor and growth by retaining the best growing dominant and codominant trees.

Tree group density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for tree groups for the SI40, SI25, and SI10 mechanical thin treatments are as described in table 125.

Table 125. Stocking guidelines for tree groups in LOPFA SI treatments

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
1 & 2 (20)	0–4.9	19	48	96	144	193	134–302	NA	NA
3 (20)	5–11.9	14	34	68	102	136	83–215	NA	NA
4 (20)	12–17.9	5	12	23	35	46	35–115	70–146	89–185
5 (20)	18–23.9	3	8	15	23	30	19–59	43–79	54–96
6 (20)	≥24	2	5	11	16	21	18–38	40–49	51–61

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2]Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Interspace width between tree groups would average from 25 to 80 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as described in table 126.

Table 126. Interspace percent and width LOPFA SI treatments

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
IT40	40–55	60–80
IT25	25–40	40–60
IT10	10–25	25–40

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c. or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11-inch d.r.c. may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation strategy), and when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired LOPFA SI forest structure, tree densities, snag densities, and CWD levels.

LOPFA Pine Sage Mechanical and Burn Treatment Design

Restore pre-settlement tree density and pattern using pre-settlement evidence as guidance.

Treatment would strive to attain an overall average density of 30 to 50 square feet of BA and 15 to 25 percent of maximum SDI inclusive of individual trees, tree groups, and interspaces. Density would vary within this range depending on existing stand structure. See section D for more detail on the relationship of overall density to interspace and tree groups.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Retain all pre-settlement trees and the largest post-settlement trees available that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences. Some younger trees would also be retained to maintain uneven-aged structure.

Replacement tree density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. See table 127 for the stocking guidelines for VSS 4, 5, and 6 tree groups for the pine-sage mechanical thin treatments.

Table 127. Stocking guidelines for VSS 4 to VSS 6 tree groups in LOPFA pine-sage treatments

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
4 (20)	12–17.9	5	12	23	35	46	35–115	70–146	89–185
5 (20)	18–23.9	3	8	15	23	30	19–59	43–79	54–96
6 (20)	≥24	2	5	11	16	21	18–38	40–49	51–61

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2]Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c. or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak would not be cut unless there is no other option to facilitate logging operations (skid trail and landing locations).

Juniper and pinyon species in the seedling/sapling, young, and mid-aged stages would generally be cut except where needed as replacements for pre-settlement trees. Mature juniper and pinyon would only be cut when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired understory composition and cover as well as LOPFA pine sage forest structure, tree densities, snag densities, and CWD levels.

Savanna/Grassland Restoration
Mechanical and Burn Treatments Design

Restore pre-settlement tree density and pattern using pre-settlement evidence as guidance. Manage for an open reference condition with 10 to 30 percent of the area under ponderosa pine and deciduous tree crowns.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Tree group arrangement, size, and density are a function of existing pre-settlement trees and evidence. Retain all pre-settlement trees and the largest post-settlement trees that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences at a 1:1 ratio. Some younger trees would also be retained to maintain uneven-aged structure. A higher leave tree to evidence ratio may be required to maintain the desired tree cover range.

Manage for a range of 70 to 90 percent of the treatment area as interspace (grass/forb) between tree groups or individuals. Amount of interspace would vary within this range depending on current conditions.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c. or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak would not be cut unless there is no other option to facilitate logging operations (skid trail and landing locations).

Juniper and pinyon species in the seedling/sapling, young, and mid-aged stages would generally be cut except where needed as replacements for pre-settlement trees. Mature juniper and pinyon would only be cut when there is no other option to facilitate logging operations (skid trail and landing locations).

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired LOPFA savanna/grassland forest structure, tree densities, snag densities, and CWD levels.

LOPFA Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height, reduce litter/duff cover, and produce effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired LOPFA forest structure, tree densities, snag densities, and CWD levels.

Goshawk PFA – Ponderosa Pine

Vegetation Management Direction: Provide for a healthy, sustainable forest environment for the post-fledgling family needs. The principle difference between “within the post-fledgling family area” and “outside the post-fledgling family area” is the higher canopy cover and smaller opening size within the post-fledgling family area. Vegetative structural stage distribution and structural conditions are the same within and outside the post-fledgling family area. Ponderosa pine canopy cover for mid-aged forest (VSS 4) should average one-third 60 plus percent and two-thirds 50 plus percent. Mature (VSS 5) and old forest (VSS 6) should average 50 plus percent. Further 4FRI direction clarifies that canopy cover guidelines apply to mid-aged to old forest structural stage dominated tree groups.

Desired Conditions: Uneven-aged with a balance of age classes. Within group structure specific to mid-aged to old classes (VSS 4 to 6) includes open understories, interlocking tree crowns, abundant large limbs, and shade.

dPFA/PFA UEA40, dPFA/PFA UEA25 and dPFA/PFA UEA10 Mechanical Thin and Burn Treatments Design

Uneven-age thinning and group selection would be used to establish interspace between individual trees and tree groups, thin tree groups, and create regeneration openings within dPFA/PFA sites with none to low dwarf mistletoe infections that are uneven age or even age with a QMD $\geq$ 8.5 inches.

Treatments would strive to attain an overall average density of 70 to 80 square feet of BA and 25 to 40 percent of maximum SDI inclusive of groups, interspaces, and regeneration openings. Density would vary within this range depending on treatment intensity and existing stand structure. See section D for more detail on the relationship of overall density to interspace, tree groups, and regeneration openings.

Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as described in table 128.

Table 128. Percent of area occupied by individual trees, tree groups, and interspace in dPFA/PFA UEA treatments

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
UEA40	45–60	40–55
UEA25	60–75	25–40
UEA10	75–90	10–25

Individual trees, tree groups, and interspaces would be managed to move toward a balance of age classes, both within and from tree group to tree group, by reducing the most abundant tree size classes and maintaining the underrepresented tree size classes.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation strategy by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

Tree groups, on average, would range in size from 0.1 to 1 acre with lower treatment intensities having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

Tree group density would be managed to meet the canopy cover requirement of 50 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for tree groups for the dPFA/PFA UEA40, UEA25, and UEA10 mechanical thin treatments are described in table 129.

Manage mid-aged, mature, and old (VSS 4, 5, and 6) tree groups for a range of density and structural characteristics by thinning approximately 50 percent of the mid-aged, mature, and old tree groups to the lower density stocking, approximately 20 percent each to the middle density and upper density stocking as displayed in the stocking guideline table, and approximately 10 percent remain unthinned.

Manage for tree groups with different age classes by retaining individual and clumps of vigorous ponderosa pine seedlings, sapling, and poles within larger mid-aged, mature, or old tree groups.

Table 129. Stocking guidelines for tree groups in dPFA/PFA WUI and UEA treatments

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
1 & 2 (20)	0–4.9	19	48	96	144	193	134–302	NA	NA
3 (20)	5–11.9	14	34	68	102	136	83–215	NA	NA
4 (20)	12–17.9	7	18	35	53	70	51–115	70–146	89–185
5 (20)	18–23.9	4	10	20	29	39	28–59	43–79	54–96
6 (20)	≥24	3	7	14	20	27	26–38	40–49	51–61

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4 classes are equivalent to 55 percent canopy cover; Densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2]Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Trees within the dominate and codominant crown position would have priority for retention within groups. Where age class diversity is not present, 1 to 10 suppressed and intermediate trees per group would be retained for vertical diversity.

Interspace width between tree groups would average from 25 to 70 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as described in table 130.

Table 130. Interspace percent and width in dPFA/PFA WUI and UEA treatments

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
UEA40	40–55	55–70
UEA25	25–40	40–55
UEA10	10–25	25–40

Regeneration openings (group selection) account for 10 to 20 percent of tree groups. They would average 0.3 to 0.8 acre and would be no larger than 2 acres or 200 feet wide. They would only be established by removing groups of trees comprised of the most abundant tree size classes. Regeneration openings would be created adjacent to tree groups and would not be surrounded by interspace.

One group of reserve trees, three to five trees per group, would be left in created regeneration openings greater than an acre in size.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c. or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11-inch d.r.c. may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation strategy), and when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired dPFA/PFA UEA forest structure, tree densities, snag densities, and CWD levels.

dPFA/PFA UEA – ADGF Design Mechanical Thin and Burn (Alternative C) Design

Same as dPFA/PFA UEA 10 with the exception of group size. Tree group size is dependent on experimental design and would range in size from 1 to 15 acres.

dPFA/PFA IT40, 25 and 10
Mechanical Thin and Burn Treatments Design

Intermediate thinning would be used to establish interspace between individual trees and tree groups and thin tree groups within dPFA/PFA sites with moderate to high dwarf mistletoe infection that are uneven age or even age with a QMD ≥ 8.5 inches.

Treatments would strive to attain an overall average density of 70 to 90 square feet of BA and 25 to 40 percent of maximum SDI inclusive of groups and interspaces. Density would vary within this range depending on treatment intensity and existing stand structure. See section D for more detail on the relationship of overall density to interspace and tree groups.

Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as described in table 131.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Table 131. Percent of area occupied by trees and interspace for dPFA/PFA IT

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
IT40	45–60	40–55
IT25	60–75	25–40
IT10	75–90	10–25

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation strategy by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

Tree groups, on average, would range in size from 0.1 to 1 acre with lower treatment intensities having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

Tree groups would be managed to improve tree vigor and growth by retaining the best growing dominant and codominant trees with the least amount of mistletoe within each group.

Tree group density would be managed to meet the canopy cover requirement of 50 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for VSS 4, 5, and 6 tree groups for the dPFA/PFA IT40, IT25, and IT10 mechanical thin treatments are described in table 132.

Table 132. dPFA/PFA IT treatments stocking guidelines for VSS 4 – 6 tree groups

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
4 (20)	12–17.9	7	18	35	53	70	51–115	70–146	89–185
5 (20)	18–23.9	4	10	20	29	39	28–59	43–79	54–96
6 (20)	≥24	3	7	14	20	27	26–38	40–49	51–61

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4 classes are equivalent to 55 percent canopy cover; Densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2]Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Interspace width between tree groups would average from 25 to 80 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as described in table 133.

Table 133. Interspace percent and width in dPFA/PFA IT

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
IT40	40–55	60–80
IT25	25–40	40–60
IT10	10–25	25–40

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c. or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11-inch d.r.c. may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation strategy); and when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired dPFA/PFA IT forest structure, tree densities, snag densities, and CWD levels.

dPFA/PFA SI40, 25, and 10 Mechanical Thin and Burn Treatments Design

Stand improvement thinning would be used to establish interspace between individual trees and tree groups and thin tree groups within dPFA/PFA even-age sites with a QMD ≤ 8.5 inches and with none to low dwarf mistletoe infection.

Treatments would strive to attain a stand average density of 20 to 25 percent of maximum SDI inclusive of groups and interspaces. These ranges would vary depending on treatment intensity and existing stand structure. See section D for more detail on the relationship of overall density to interspace and tree groups.

Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as described in table 134.

Table 134. Percent of area occupied by individual trees, tree groups, and interspaces in dPFA/PFA SI treatments

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
SI40	45–60	40–55
SI25	60–75	25–40
SI10	75–90	10–25

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy, and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation strategy by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

Tree groups, on average, would range in size from 0.1 to 1 acre with lower treatment intensities having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

Tree groups would be managed to improve tree vigor and growth by retaining the best growing dominant and codominant trees.

Tree group density would be managed to meet the canopy cover requirement of 50 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for tree groups for the dPFA/PFA SI40, SI25, and SI10 mechanical thin treatments are described in table 135.

Table 135. Stocking guidelines for tree groups in dPFA/PFA SI treatments

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
1 & 2 (20)	0–4.9	19	48	96	144	193	134–302	NA	NA
3 (20)	5–11.9	14	34	68	102	136	83–215	NA	NA
4 (20)	12–17.9	7	18	35	53	70	51–115	70–146	89–185
5 (20)	18–23.9	4	10	20	29	39	28–59	43–79	54–96
6 (20)	≥24	3	7	14	20	27	26–38	40–49	51–61

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4 classes are equivalent to 55 percent canopy cover; densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2] Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Interspace width between tree groups would average from 25 to 80 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as described in table 136.

Table 136. Interspace percent and width in dPFA/PFA SI treatments

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
SI40	40–55	60–80
SI25	25–40	40–60
SI10	10–25	25–40

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c. or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species would not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11-inch d.r.c. may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation strategy); and when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5-inch drc may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired dPFA/PFA SI forest structure, tree densities, snag densities, and CWD levels.

dPFA/PFA Pine Sage Mechanical and Burn Treatment Design

Restore pre-settlement tree density and pattern using pre-settlement evidence as guidance.

Treatments would strive to attain an overall stand average density of 30 to 50 square feet of BA and 15 to 25 percent of maximum SDI inclusive of individual trees, tree groups, and interspaces. Density would vary within this range depending on existing stand structure. See section D for more detail on the relationship of overall density to interspace and tree groups.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy, and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Retain all pre-settlement trees and the largest post-settlement trees available that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences. Some younger trees would also be retained to maintain uneven-aged structure.

Replacement tree density would be managed to meet the canopy cover requirement of 50 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for VSS 4, 5, and 6 tree groups for the pine sage mechanical thin treatments are as described in table 137.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak would not be cut unless there is no other option to facilitate logging operations (skid trail and landing locations).

Table 137. Stocking guidelines for VSS 4–6 tree groups in dPFA/PFA pine-sage treatments

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
4 (20)	12–17.9	7	18	35	53	70	51–115	70–146	89–185
5 (20)	18–23.9	4	10	20	29	39	28–59	43–79	54–96
6 (20)	≥24	3	7	14	20	27	26–38	40–49	51–61

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4 classes are equivalent to 55 percent canopy cover; densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2]Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Juniper and pinyon species in the seedling/sapling, young, and mid-aged stages would generally be cut except where needed as replacements for pre-settlement trees. Mature juniper and pinyon would only be cut when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired dPFA/PFA savanna/grassland forest structure, tree densities, snag densities, and CWD levels.

dPFA/PFA Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height, reduce litter/duff cover, and produce effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired dPFA/PFA forest structure, tree densities, snag densities, and CWD levels.

Nest Area

Vegetation Management Direction: Provide unique nesting habitat conditions for goshawks. Important features include trees of mature to old age with high canopy cover. The structure of the vegetation within nest areas is associated with the forest type, and tree age, size and density, and the developmental history of the stand. Table 138 represents GTR-RM-217 attributes required for goshawks on location with “low” and “high” site productivity. The nesting area contains only mature to old forest (VSS 5 and 6) having a canopy cover (measured vertically) between 50 to 70 percent with old forest VSS 6 trees 200 to 300 years old. Nonuniform spacing of tree and clumpiness is desirable.

Desired Conditions: Even-aged dominated by mature and/or old forest structural stages.

Goshawk Nest Area Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height and reduce litter/duff cover and other surface fuel loading.

Prescribed fires are designed to maintain and enhance desired dPFA/PFA forest structure, tree densities, snag densities, and CWD levels. Desired goshawk nest stand structural attributes are as described in table 138.

Table 138. Minimum structural attributes in suitable goshawk nest stands*

Structural Attribute	Minimum Metrics	
Site Index	<55	≥55
Trees/Acre	40	30
Mean d.b.h. (in.)	16	22
Age (yrs.)	200+	200+
Total BA (sq. ft./acre)	120	140
Overstory canopy cover	50+	60+
VSS	5B-6	5B-6

* GTR-RM-217, southwest ponderosa pine cover types

Landscapes Outside of Goshawk Post-fledgling Areas (LOPFA) – Pinyon-Juniper

Vegetation Management Direction: Manage for uneven-age conditions to sustain a mosaic of vegetation densities (overstory and understory), age classes, and species composition well distributed across the landscape. Provide for reserve trees, snags, and down woody debris.

Desired Conditions: Mosaic of young and mature, species diverse patches of trees interspersed with interspace across the landscape to promote the growth of sagebrush, oak, cliffrose, and other shrubs and herbaceous understory species. Mature patches would be structurally diverse, containing large live and dead standing trees as well as trees with dead or broken tops, gnarls, and burls. The structure and composition reflects the natural range of variation.

Pinyon Juniper (PJ) WUI Mechanical Thin and Burn Treatment Design

Uneven-age thinning would be used to establish interspace between tree groups and thin tree groups within LOPFA PJ sites.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy, and old trees would not be targeted for cutting. Live conifer trees with existing cavities and dead tops would also be favored for retention.

Retain one to three groups per acre containing approximately 5 to 30 trees each (averaging 30 to 60 trees per acre across the site). Form groups around existing concentrations of large, mature trees. Retain additional healthy, young, free-to-grow trees within groups where possible.

Between groups, thin from below to 16-inch d.r.c. for pinyon and juniper and 16-inch d.b.h. for ponderosa pine (see next).

Where ponderosa pine is present, retain all pre-settlement yellow pines and one to two replacement blackjacks per existing yellow pine or pre-settlement evidence (i.e., to approximate the naturally occurring stand composition). Replacement blackjacks should be comprised of a variety of size classes. Blackjacks would be retained within 100 feet of the yellow pine or pre-settlement evidence they are replacing.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c. or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak would not be cut with the exception of when there is no other option to facilitate logging operations (skid trail and landing locations).

Snags would be managed for one per acre over 75 percent of the area and CWD would be managed for an after treatment average of 1 to 3 tons per acre. Where available, a portion of the CWD would include two logs ≥10 inches and ≥10 feet in length.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired LOPFA PJ WUI forest structure, tree densities, snag densities, and CWD levels.

Other Areas Outside MSO and Goshawk Habitats

Aspen

Vegetation Management Direction: Conifer removal, partial removal of overstory aspen, ground-disturbing activities, and fire would be used to stimulate aspen sprouting in areas that have or previously had aspen.

Desired Conditions: Aspen is successfully regenerating and recruiting into older and larger size classes. Size classes have a natural distribution, with the greatest number of stems in the smallest classes. Coniferous species comprise less than 10 percent of the overstory.

Aspen Mechanical Thin and Burn Treatment Design

Inclusions of aspen remnants within portions of ponderosa pine stands would be regenerated by removing all post-settlement conifers from within 100 feet of the aspen clone. Some removal of aspen within the clone as well as ground-disturbing activity or burning may occur to stimulate suckering.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy, and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

Each clone would be evaluated as to need for fencing or creation of other barriers to reduce ungulate browsing of regenerating aspen.

Prescribed burns may be used where and when feasible to treat fuels, mitigate fuel hazards, and to produce effects that stimulate aspen suckering and regeneration, and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired aspen forest structure, tree densities, snag densities, and CWD levels.

Aspen Burn Only Treatment Design

Inclusions of aspen remnants within portions of ponderosa pine stands would be regenerated by prescribed burning to stimulate suckering.

Prescribed burns are designed to reduce post-settlement conifer stocking within 100 feet of the aspen clone and disturb the site with sufficient intensity to encourage aspen regeneration.

Each clone would be evaluated as to need for fencing or creation of other barriers to reduce ungulate browsing of regenerating aspen.

Grassland

Vegetation Management Direction: Reduce conifer encroachment within grasslands as identified by mollisol soils.

Desired Conditions: Restore historic grassland/forest edge as indicated by existing pre-settlement conifers and evidence of pre-settlement conifers.

Grassland Mechanical Thin and Burn Treatment Design (Alternative C Only)

Treatments are designed to promote and reestablish the historic meadow edge as defined by pre-settlement trees and evidences and the current forest structure of young trees encroaching on the edge of the grassland.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation strategy, and old trees would not be targeted for cutting. Live conifer trees with existing cavities and dead tops would also be favored for retention.

Tree group arrangement, size, and density are a function of existing pre-settlement trees and evidence. Retain all pre-settlement trees and the largest post-settlement trees that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences at a 1:1 ratio. Ponderosa pine, pinyon, and juniper not meeting long-lived characteristics may be removed.

Gambel oak would be retained.

Prescribed burns may be used where and when feasible to treat fuels, mitigate fuel hazards, and to produce effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired grassland conditions.

Section B – Decision Matrix

Table 139. Section B decision matrix for establishing tree groups, interspace, and regeneration openings

Feature	Placement	Reserve Trees within Feature	Thinning	Thinning Leave Tree Criteria	Large Tree Implementation Plan (Alternative C)
Tree Group	1 – Abundance of pre-settlement tree evidence 2 – Underrepresented tree classes (e.g., free to grow seedling/saplings; trees of different cohort than neighboring trees) 3 – High percentage of trees exhibiting good health and vigor	1 – Old tree characteristics (old tree implementation plan) regardless of size 2 – Oak, pinyon, and juniper with exceptions 3 – Wildlife trees (cavities, dead tops)	Tree group stocking guidelines	1 – Trees in the dominant and codominant crown position exhibiting vigor relative to age regardless of size 2 – Crown ratio >40% desirable; crown ratio 25–40% acceptable 3 – Free of mistletoe or low dwarf mistletoe rating relative to neighboring trees; free of pine beetle activity 4 – Trees >12″ high percentage of interlocking crown; Trees <12″ ability to develop interlocking crown	Heavily-Stocked Stands (with high BA) Generated by a Preponderance of Large, Young Trees Does the decision matrix meet the conditions described by the large tree implementation plan category: Yes ______ No ______ If no, describe what the condition(s) is, and why it does not meet the exception: ______________________________________ ______________________________________ Ponderosa Pine/Gambel Oak Forest Does the decision matrix meet the conditions described by the large tree implementation plan category: Yes ______ No ______ If no, describe what the condition(s) is, and why it does not meet the exception: ______________________________________ ______________________________________

Feature	Placement	Reserve Trees within Feature	Thinning	Thinning Leave Tree Criteria	Large Tree Implementation Plan (Alternative C)
Interspace	1 – Little to no pre–settlement tree evidence 2 – Existing nonstocked openings 3 – High percentage of trees exhibiting poor health and vigor 4 - Contiguous area of well-represented cohorts	1 – Old tree characteristics (old tree implementation plan) regardless of size. 2 – Oak, pinyon and juniper 3 – Wildlife trees (cavities, dead tops)	NA	NA	Within-Stand Openings: Does the decision matrix meet the conditions described by the large tree implementation plan category: Yes ______ No ______ If no, describe what the condition(s) is, and why it does not meet the exception: ____________________________________ ____________________________________
Regeneration Opening	1 – Contiguous area of well-represented cohort. 2 – Isolated patch of mistletoe infected trees within the well-represented cohort. 3 – Adjacent to seed bearing tree groups that are free of mistletoe infection.	1 – Old tree characteristics (old tree implementation plan) regardless of size. 2 – Oak, pinyon, and juniper 3 – Wildlife trees (cavities, dead tops) 4 – Largest, healthiest, seed bearing ponderosa pine (within openings >1 ac)	NA	NA	NA

Section C – Old Tree Implementation Plan

Old Tree Descriptions and Illustrations

Old trees (approximately >150 years old) would be retained, with few exceptions, regardless of their diameter, within the 4FRI on the Coconino and Kaibab NF's EIS area. Removal of old trees would be rare. Exceptions would be made for threats to human health and safety, and those rare circumstances where the removal of an old tree is necessary in order to prevent additional habitat degradation. Old trees would not be cut for forest health issues or to balance age or size class distributions.

One example of a situation where the removal of an old tree is necessary in order to prevent additional habitat degradation is in the rare case of an old tree growing on the side of an existing curve in a road. Logging equipment may require a wider turning radius. The options are to relocate the road or cut the old tree and widen the curve to accommodate the larger turning radius. Relocating the road would result in a larger area of the forest being permanently disturbed, versus cutting the large tree and widening the curves radius. This is an example where cutting the old tree would result in less habitat degradation then relocating a road.

Old trees would be determined by the following characteristics described by Thomson (1940) as age class 3 (intermediate-mature) and age class 4 (mature-overmature).

- Age – Approximately 150 years and older.
- D.b.h. – Site dependent.
- Bark – ranging from reddish brown, shading to black in the top with moderately large plates between the fissures to reddish brown to yellow, with very wide, long, and smooth plates.
- Tops – ranging from pyramidal or rounded (occasionally pointed) to flat (making no further height growth).
- Branching – ranging from upturned in upper third of the crown, horizontal in the middle third, and drooping in the lower third of the crown to mostly large, drooping, gnarled, or crooked. Branch whorls range from incomplete and indistinct except at the top to completely indistinct and incomplete.

Figure 72 and figure 73 display illustrations of age class 3 (intermediate-mature) and age class 4 (mature-overmature) from Thompson 1940.

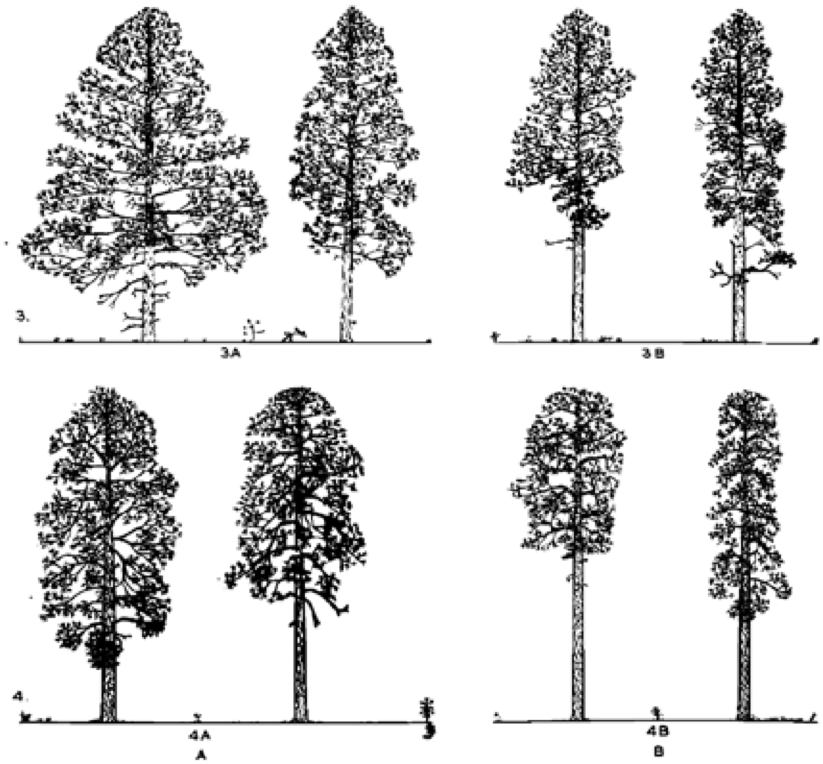

Figure 72. Old tree characteristics (Thompson 1940)

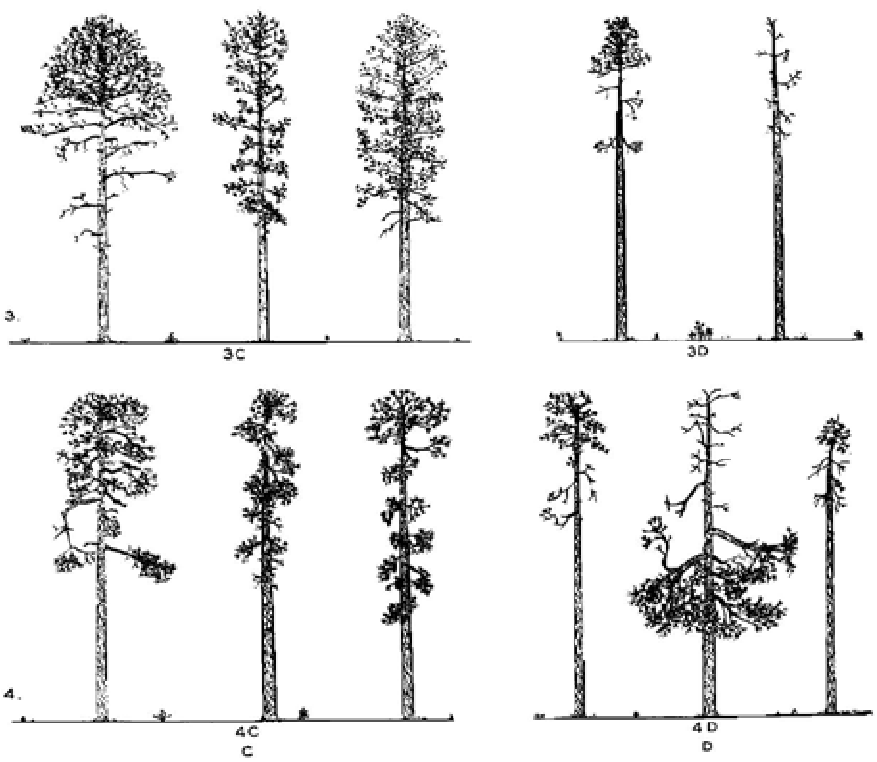

Figure 73. Old age tree characteristics continued (Thompson 1940)

Section D – Modified Large Tree Implementation Plan (Alternative C)

Introduction

The large tree implementation plan is specific to alternative C. It is designed to inform implementation. It responds to comments received during scoping (August 2011). The plan's desired conditions are consistent with the summarized desired conditions found in the project's purpose and need and the plan provides additional citations that support the desired conditions. It incorporates the old tree implementation plan be reference.

For the purpose of this document, large post-settlement trees, as defined by the socio-political process, are those that are 16-inch d.b.h. or larger. Trees greater than or equal to 18-inch d.b.h. represent VSS 5 and 6. VSS 5 and 6 represent the largest and (sometimes) oldest trees. These size classes best correspond with the successional stage classification system that was developed to address the forest dynamics of southwestern ponderosa pine.

The plan may not include every instance where large post-settlement trees may be cut. There may be additional areas and/or circumstances where large post-settlement trees need to be removed in order to achieve restoration objectives. During implementation (prescription development), if a condition exists that does not the meet the desired conditions included in this strategy, no large trees would be cut until the NEPA decision is reviewed by the Forest Service implementation team. The team would decide whether the action is consistent with the analysis and the decision made. This information would be made part of the annual implementation plan checklist/compliance review that is recommended by the team and approved by the forest supervisor.

Seeps and Springs

Seeps are locations where surface-emergent groundwater causes ephemeral or perennial moist soil or bedrock. Standing or running water is infrequent or absent. Vegetation and other biological diversity are adapted to mesic soils. Springs are small areas where surface-emergent groundwater causes ephemeral or perennial standing or running water and wet or moist soils. Vegetation and other biological diversity are adapted to mesic soils or aquatic environments (Feth and Hem 1963).

Seeps and springs exhibit unique, often isolated biophysical conditions that can sustain unique, mesic-adapted biological diversity, and can facilitate endemism and speciation. Springs also provide water and other habitat to terrestrial wildlife. Due to the absence of frequent fires in the presence of livestock grazing, the establishment of large post-settlement trees may reduce available soil moisture (Simonin et al. 2007) and block the sunlight necessary to support the unique biophysical conditions associated with seeps and springs.

Removal of trees that have encroached upon seeps and springs may constitute a relatively small part of an overall seep and spring restoration effort, when compared to fully addressing root causes of overall degradation. Thinning alone, without addressing other sources of degradation, is unlikely to fully restore seeps and springs (Thompson et al. 2002). However, it is a necessary step leading to the restoration of these ecologically important areas.

Desired Conditions

- The biophysical conditions in seeps and springs upon which terrestrial, mesic-adapted, and aquatic native biological diversity depend are conserved and restored.
- The integrity of the spring's unique biophysical attributes is not compromised by tree shading.
- Mesic soils associated with a seep or spring are not encroached upon by conifers.
- If treatment occurs, an equivalent number of large replacement trees remain where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past.

Riparian

Riparian areas occur along ephemeral or perennial streams or are located downgradient of seeps or springs. These areas exhibit riparian vegetation, mesic soils, and/or aquatic environments.

Riparian areas exhibit unique biophysical conditions that can sustain unique, mesic-adapted, or aquatic biological diversity. Riparian areas and the streams, springs, and seeps connected to them often harbor imperiled species that can be sources of endemism. Riparian areas also provide water and other habitat to terrestrial wildlife. In the absence of frequent fires and in the presence of other competing factors, large post-settlement trees may have become established and grown within riparian areas to the point that they compromise available soil moisture or light that support the unique biophysical conditions that are associated with the riparian areas. However, it is likely to be a very rare circumstance that conifer trees of any size would need to be removed from forested riparian zones.

Desired Conditions

- The biophysical conditions in riparian habitat upon which terrestrial and aquatic native biological diversity depends are conserved and restored.
- The use of soil and water best management practices (BMPs) minimize the impacts of cutting trees within riparian areas.
- Removal of trees constitutes a relatively small part of an overall riparian area restoration effort, when compared to the fundamental causes of overall degradation. Riparian areas are fully restored by using an array of tools that address all sources of degradation.
- Available soil moisture or light that support that area's unique biophysical conditions is not compromised by growing (rooted) trees.
- If treatment occurs, an equivalent number of large replacement trees remain where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past.
- Post-treatment snags and logs that include large trees are available onsite.

Wet Meadows

High elevation streamside or spring-fed meadows occur in numerous locations throughout the Southwest. However, less than 1 percent of the landscape in the region is characterized as wetland

(Dahl 1990), and wet meadows are just one of several wetland types that occur. Patton and Judd (1970) reported that approximately 17,700 hectares of wet meadows occur on national forests in Arizona and New Mexico.

Wet meadows may be referred to as riparian meadows, montane (or high elevation) riparian meadows, sedge meadows, or simply as wet meadows. Wet meadows are usually located in valleys or swales, but may occasionally be found in isolated depressions, such as along the fringes of ponds and lakes with no outlets. Where wet meadows have not been excessively altered, sedges (*Carex* spp.), rushes (*Juncus* spp.), and spikerush (*Eleocharis* spp.) are common species (Patton and Judd 1970, Hendrickson and Minckley 1984, Muldavin et al. 2000). Willow (*Salix*) and alder (*Alnus*) species often occur in or adjacent to these meadows (Long 2000, Long 2002, Maschinski 2001, Medina and Steed 2002). High elevation wet meadows frequently occur along a gradient that includes aquatic vegetation at the lower end and mesic meadows, dry meadows, and ponderosa pine or mixed conifer forest at the upper end. These vegetation gradients are closely associated with differences in flooding, depth to water table, and soil characteristics (Judd 1972, Castelli et al. 2000, Dwire et al. 2006). While relatively rare, wet meadows are believed to be of disproportionate value because of their use by wildlife and the range of other ecosystem services they provide. Wet meadows perform many of the same ecosystem functions associated with other wetland types, such as water quality improvement, reduction of flood peaks, and carbon sequestration.

Wet meadows are one of the most heavily altered ecosystems. They have been used extensively for grazing livestock, have become the site of many small dams and stock tanks, have had roads built through them, and have experienced other types of hydrologic alterations. Most notably, the lowering of their water tables due to stream downcutting, surface water diversions, or groundwater withdrawal (Neary and Medina 1996) has occurred. In the presence of livestock grazing and hydrologic changes, large post-settlement trees may have established and grown within wet meadows such that they compromise available soil moisture or light creating unique biophysical conditions.

Desired Conditions

- The biophysical conditions of wet meadows upon which terrestrial native biological diversity depend are conserved and restored.
- Wet meadow function is not impaired by growing (rooted) trees.
- If treatment occurs, an equivalent number of large replacement trees remain where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past.
- Removal of large trees constitutes a relatively small part of an overall riparian area restoration effort, when compared to the fundamental causes of overall degradation. Wet meadows are fully restored by using an array of tools that address all sources of degradation.

Encroached Grasslands

Encroached grasslands are herbaceous ecosystems that have infrequent to no evidence of pine trees growing prior to settlement. The two prevalent grassland categories in the 4FRI landscape are montane (includes subalpine) grasslands and Colorado Plateau (a subset of Great Basin) grasslands, with montane grasslands being most common (Finch 2004). A key indicator of grasslands is the presence of mollisol soils. Mollisol soils are typically deeper with higher rates of accumulation and decomposition of soil organic matter relative to soils in the surrounding landscape. Grasslands in this region evolved during the Miocene and Pliocene periods, and the dark, rich soils observed in grasslands today have taken more than 3 million years to produce. In addition to their association with mollic soils, grasslands in this region are maintained by a combination of climate, fire, wind desiccation and, to a lesser extent, by animal herbivory (Finch 2004).

Typical montane grasslands in this region are characterized by Arizona fescue (*Festuca arizonica*) meadows on elevated plains of basaltic and sandstone residual soils. Montane grasslands generally occur in small (<100 acres) to medium sized (100 to 1,000 acres) patches. Historic maintenance of the herbaceous condition in these grasslands is subject to some debate though appears to be primarily driven by periodic fire. The cool-season growth of Arizona fescue also plays a large role in maintenance of parks and openings by directly competing with ponderosa pine seedlings. Identification of grasslands in this region should use a combination of the TES, Southwest Regional GAP Analysis, and Brown and Lowe Vegetation Classification (Brown and Lowe 1982, TNC GIS Layer 2006) among other existing vegetation and soils data.

Prior to European settlement, pine trees were rarely established in grasslands because they were either outcompeted by production of cool-season grasses or killed by frequent fire (Finch 2004). In the late 1800s, unsustainable livestock grazing practices significantly reduced herbaceous cover, reducing competition pressure on pine seedlings. Coupled with the onset of fire suppression in the early 1900s, pine trees rapidly encroached and recruited into native grasslands (e.g., Moore and Huffman 2004, Coop and Givnish 2007). Plant diversity is particularly important in grassland ecosystems. Grassland plots with greater species diversity have been found to be more resistant to drought and to recover more quickly than less diverse plots (Tilman and Downing 1994). This resilience will become even more important in a warming climate. Pine tree removal, restoration of fire, and complementary reductions in livestock grazing pressure are all necessary to restore structure and function of native grasslands.

Desired Conditions

- Grasslands are enhanced, maintained, and function with potential natural vegetation (as defined by vegetative mapping units).
- Grasslands function with a natural fire regime.
- Existing grasslands are not encroached upon by conifers.
- If treatment occurs, an equivalent number of large replacement trees remain where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past.

Aspen Forest and Woodland

Quaking aspen (*Populus tremuloides*) occurs in small patches throughout the 4FRI project area. Bartos (2001) refers to three broad categories of aspen: (1) stable and regenerating (stable), (2) converting to conifers (seral), and (3) decadent and deteriorating. Almost all of the aspen occurring within ponderosa pine forests of the 4FRI project area is seral aspen, which regenerates after disturbance through root sprouting and rarely from seed production (Quinn and Wu 2001).

Favorable soil and moisture conditions maintain stable aspen over time. Aspen stands have been mapped across the entire 4FRI area and map layers are available from existing databases.

Aspen occurs within ponderosa pine forests. It is ecologically important due to the high concentration of biodiversity that depends on aspen for habitat (Tew 1970, DeByle 1985, Finch and Reynolds 1987, Griffis-Kyle and Beier 2003). In addition, stable aspen stands serve as an indicator of ecological integrity (Di Orio et al. 2005). Aspen is currently declining at an alarming rate (Fairweather et al. 2008).

The lack of fire as a natural disturbance regime in southwestern ponderosa pine forests since European settlement has caused much of the aspen dominated lands to cede to conifers (Bartos 2001). Other factors contributing to gradual aspen decline over the past 140 years include reduced regeneration from browsing ungulates (Pearson 1914, Larson 1959, Martin 1965, Jones 1975, Shepperd and Fairweather 1994, Martin 2007). More recently, aerial and ground surveys indicate more rapid decline of aspen, with very high mortality occurring in low and mid-elevation aspen sites. Major factors thought to be causing this rapid decline of aspen include frost events, severe drought, and a host of insects and pathogens (Fairweather et al. 2008) that have served as the “final straws” for already compromised stands.

Desired Conditions

- Aspen forests and woodlands are conserved and restored to their appropriate fire regime.
- Aspen is effectively being regenerated or maintained, and regeneration, saplings, and juvenile trees are protected from browsing.
- There is decreased competition from ponderosa pine. Post-settlement ponderosa pine tree numbers do not exceed residual targets that have been identified using pre-settlement conifer tree evidences, site visitations, and collected data.
- Removal of large trees constitutes a relatively small part of the aspen restoration effort, when compared to the fundamental causes of overall degradation. Aspen forests and woodlands are fully restored by using an array of tools that address all sources of degradation.

Ponderosa Pine/Gambel Oak Forest (Pine-Oak)

A number of habitat types exist in the southwestern United States that could be described as pine-oak. Ponderosa pine forests are interspersed with Gambel oak trees in locations throughout the 4FRI area in a habitat association referred to as PIPO/QUGA (USFS 1997, USDI 1995).

In southwestern ponderosa pine forests, Gambel oak has several growth forms distinguished by stem sizes and the density and spacing of stems within clumps. These include shrubby thickets of small stems, clumps of intermediate-sized stems, and large, mature trees that are influenced by age, disturbance history, and site conditions (Kruse 1992, Rosenstock 1998, Abella and Springer 2008, Abella 2008a). Different growth forms provide important habitat for a large number and variety of wildlife species (Neff et al. 1979, Kruse 1992). These include hiding cover in a landscape with limited woody shrub cover, cavity substrate for birds and bats, roost potential for bats, nest sites for birds, and bark characteristics used by invertebrates. Whether as saplings, shrubby thickets, or larger sized trees, oak adds a high value for wildlife in ponderosa pine forests.

Gambel oak provides high quality wildlife habitat in its various growth forms and is a desirable component of ponderosa pine forests (Neff et al. 1979, Kruse 1992, Bernardos et al. 2004). Gambel oak enhances soils (Klemmedson 1987), wildlife habitat (Kruse 1992, Rosenstock 1998, USDI 1995, Bernardos et al. 2004), and understory community composition (Abella and Springer 2008). Large oak trees are particularly valuable since they typically provide more natural cavities and pockets of decay that allow excavation and use by cavity nesters than conifers. In addition to its important ecological role, Gambel oak has high value to humans as it is a popular firewood that possesses superior heat-producing qualities compared to other tree species (Wagstaff 1984).

Although management on public lands with regard to oak has changed to better protect the species, illegal firewood cutting of Gambel oak, and elk and livestock grazing negatively impact oak growth and regeneration (Harper et al. 1985, Clary and Tiedemann 1992). Illegal firewood cutting of Gambel oak continues to result in the removal of rare, large diameter oak trees (Bernardos et al. 2004).

A literature review by Abella and Fulé (2008) found that Gambel oak densities appear to have increased in many areas with fire exclusion, especially in the small and medium diameter stems (<8-inch d.b.h.). Chambers (2002) found that Gambel oak on the Kaibab and Coconino NFs was distributed in an uneven-aged distribution, dominated by smaller size classes (<5 centimeter d.b.h.) and few large diameter oak trees. Because of Gambel oak's slow growth rate, there may be little opportunity for these small Gambel oak trees to attain large diameters (>85 centimeters) (Chambers 2002).

Pine competition with oak has been identified as an issue in slowing oak growth, particularly for older oaks (Onkonburi 1999). Onkonburi (1999) also found that for northern Arizona forests, pine thinning increased oak incremental growth more than oak thinning and prescribed fire. Fulé (2005) found that oak diameter growth tended to be greater in areas where pine was thinned relative to burn only treatments and controls. Thinning of competing pine trees may promote large oaks with vigorous crowns and enhanced acorn production (Abella 2008b), and may increase oak seedling establishment (Ffolliott and Gottfried 1991).

Desired Conditions

All Gambel Oak

- Small oak trees develop into larger size classes.
- Fire treatments retain small and shrubby oak in numbers and distribution.
- All growth forms of Gambel oak are present and larger, older oak trees are enhanced and maintained.
- Large, post-settlement trees are not restricting oak development.
- Frequent, low intensity surface fire occurs in ponderosa pine-Gambel oak forests.
- Brushy thicket, pole, and dispersed clump growth forms of Gambel oak are present and maintained by allowing natural self-thinning, thinning dense clumps, and/or burning.
- Gambel oak growth forms are protected from damage during restoration treatments including thinning and post-thinning slash burning.

In MSO Restricted Habitat

- Within MSO habitat and designated critical habitat, the recovery plan for the MSO improves key habitat components and primary biological factors, which includes Gambel oak.
- Within 30 feet of oak 10- inch d.r.c. or larger, post-settlement mixed conifer trees up to 18-inch d.b.h. (that do not have interlocking crowns with oak) are not restricting oak development.

Outside MSO Restricted Habitat

- Large post-settlement trees' drip lines or roots do not overlap with those of Gambel oak trees exhibiting >8 inch d.r.c.

Within-stand Openings

Within-stand openings are small openings (generally 0.05 to 1.0 acres) that were occupied by grasses and wildflowers before settlement (Pearson 1942, White 1985, Covington and Sackett 1992, Sánchez Meador et al. 2009). For the purposes of this strategy, within-stand openings are equivalent to interspaces. The within-stand opening management approach described below is distinct from, and should not be considered as guidance relating to regeneration openings.

Pre-settlement openings can be identified by the lack of stumps, stump holes, and other evidence of pre-settlement tree occupancy (Covington et al. 1997). These openings are most pronounced on sites with heavy textured (e.g., silt-clay loam) soils (Covington and Moore 1994). Current openings include fine-scaled canopy gaps. It is not necessary to have desired within-stand openings and groups located in the same location that they were in before settlement (the site fidelity assumption). Trees might be retained in areas that were openings before settlement, and openings might be established in areas which had previously supported pre-settlement trees.

Within-stand openings appear to have been self-perpetuating before overgrazing and fire exclusion (Pearson 1942, Sánchez Meador et al. 2009). Fully occupied by the roots of grasses and wildflowers as well as those of neighboring groups of trees, these openings had low water and nutrient availability because of intense root competition (Kaye et al. 1999). Heavy surface fuel loads insured that tree seedlings were killed by frequent surface fires, reinforcing the competitive exclusion of tree seedlings (Fulé et al. 1997).

These natural openings appear to have been very important for some species of butterflies, birds, and mammals (Waltz and Covington 2004). Often the largest post-settlement trees, typically a single tree, became established in these natural within-stand openings as soon as herbaceous vegetation was removed by overgrazing (Sánchez Meador et al. 2009). Contemporary within-stand openings or areas dominated by smaller post-settlement trees should be the starting point for restoring more natural within-stand heterogeneity.

Desired Conditions

- The pattern of openings within stands that provide natural spatial heterogeneity for biological diversity are conserved.
- Openings break up fuel continuity to reduce the probability of torching and crowning and restore natural heterogeneity within stands.

- Openings promote snowpack accumulation and retention which benefits groundwater recharge and watershed processes at the fine (1 to 10 acres) scale.
- The presence of such trees does not prevent the reestablishment of sufficient within-stand openings to emulate natural vegetation patterns based on current stand conditions, pre-settlement evidences, desired future conditions, or other restoration objectives.
- Groups of trees typically range in size from 0.1 acre to 1 acre. Canopy gaps and interspaces between tree groups or individuals are based on site productivity and soil type and range from 10 percent on highly productive sites to as high as 90 percent on those soil types that have an open reference condition.
- Suitable openings for successful natural regeneration in this project would range in size from 3/10 to 8/10 of an acre.

Heavily-Stocked Stands (with High Basal Area) Generated by a Preponderance of Large, Young Trees

In some areas, the increase in post-settlement trees has been so rapid that current stand structure is characterized by high density and high basal area in large, young ponderosa pine trees. These stands or groups of stands exhibit continuous canopy which promotes unnaturally severe fire effects under severe fire weather conditions. At the fine scale, the management approach would apply on a case-by-case basis. The cutting of large trees may be necessary to meet site-specific ecological objectives as listed below. For example, the cutting of large trees may be necessary in order to reduce the potential for crown fire to spread into communities or important habitats that include MSO and/or goshawk nest stands. This approach would apply when other options would not alleviate severe fire effects.

In stands where pre-settlement evidences, restoration objectives, community protection, or other ecological restoration objectives indicate much lower tree density and basal area would be desirable, large post-settlement pines may need to be removed to achieve post-treatment conditions consistent with a desired restoration trajectory. Where evidence indicates higher tree density and basal area would have occurred pre-settlement, only a few large pines may need to be removed. Many of these areas would support crown fire and, thus, require structural modification to reduce crown fire potential and restore understory vegetation that supports surface fire.

Desired Conditions

- Natural heterogeneity of forest, savanna, and grasslands occurs at the landscape scale and within stands.
- Groups are restored by retaining the largest trees on the landscape to reestablish old growth structure in the shortest timeframe possible.
- Decreased shading and interception from the canopy, decreased needle litter and duff, and surface fire restore and maintain a mosaic of natural vegetative communities.
- Decreased shading and interception from the canopy fuels allow the growth of continuous herbaceous surface fuels to carry surface fire.
- Reduced horizontal and vertical canopy fuels reduce the potential for crown fire.
- Fire is the principle regulator of forest structure over time.

- Regeneration openings that contribute to the ecological objective of natural heterogeneity of historical forest structure and age class diversity are not encroached upon by trees.

Section E – Density Management and the Relationship Between Treatment Intensity, Tree Group Density, and Overall Average Density

Table 140. Section E the relationship between treatment intensity, tree group density, and overall average density

Treatment Intensity	Percent of Area		Percent of Treed Area		Avg. Group BA to Achieve Overall BA of:					
	Interspace	Tree	Groups and Individuals	Regeneration	40	50	60	70	80	90
10–25	**10**	**90**	90	0		56	67	78	89	100
			85	5		59	71	82	94	
			80	10		63	75	88	100	
			75	15		67	80	93	107	
			70	20		71	86	100	114	
	15	**85**	85	0		59	71	82	94	106
			80	5		63	75	88	100	
			75	10		67	80	93	107	
			70	15		71	86	100	114	
			65	20		77	92	108	123	
	20	**80**	80	0		63	75	88	100	113
			75	5		67	80	93	107	
			70	10		71	86	100	114	
			65	15		77	92	108	123	
			60	20		83	100	117	133	
25–40	**25**	**75**	75	0		67	80	93	107	120
			70	5		71	86	100	114	
			65	10		77	92	108	123	
			60	15		83	100	117	133	
			55	20		91	109	127	145	
	30	**70**	70	0		71	86	100	114	129
			65	5		77	92	108	123	
			60	10		83	100	117	133	
			55	15		91	109	127	145	

Treatment Intensity	Percent of Area		Percent of Treed Area		Avg. Group BA to Achieve Overall BA of:					
	Interspace	Tree	Groups and Individuals	Regeneration	40	50	60	70	80	90
			50	20		100	120	140	160	
	35	**65**	65	0		77	92	108	123	138
			60	5		83	100	117	133	
			55	10		91	109	127	145	
			50	15		100	120	140	160	
			45	20		111	133	156	178	
40–55	**40**	**60**	60	0	67	83	100	117	133	150
			55	5	73	91	109	127	145	
			50	10	80	100	120	140	160	
			45	15	89	111	133	156	178	
			40	20	100	125	150	175	200	
	45	**55**	55	0	73	91	109	127	145	164
			50	5	80	100	120	140	160	
			45	10	89	111	133	156	178	
			40	15	100	125	150	175	200	
			35	20	114	143	171	200	229	
	50	**50**	50	0	80	100	120	140	160	180
			45	5	89	111	133	156	178	
			40	10	100	125	150	175	200	
			35	15	114	143	171	200	229	
			30	20	133	167	200	233	267	
55–70	**55**	**45**	45	0	89	111	133	156		
			40	5	100	125	150	175		
			35	10	114	143	171	200		
			30	15	133	167	200	233		
			25	20	160	200	240	280		
	60	**40**	40	0	100	125	150	175		
			35	5	114	143	171	200		
			30	10	133	167	200	233		
			25	15	160	200	240	280		
			20	20	200	250	300	350		

Treatment Intensity	Percent of Area		Percent of Treed Area		Avg. Group BA to Achieve Overall BA of:					
	Interspace	Tree	Groups and Individuals	Regeneration	40	50	60	70	80	90
	65	**35**	35	0	114	143	171	200		
			30	5	133	167	200	233		
			25	10	160	200	240	280		
			20	15	200	250	300	350		
			15	20	267	333	400	467		

Note: Red fill indicates red SDI zone for all diameters. Red zone group BA ranges from 125 BA for 8-inch QMD to 195 BA for 24-inch QMD.
* Average Group Basal Area (BA) to achieve overall BA.

TPA by QMD and BA:

	Grp BA																												
Grp QMD	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**	**105**	**110**	**115**	**120**	**125**	**130**	**135**	**140**	**145**	**150**	**155**	**160**	**165**	**170**	**175**	**180**	**185**	**190**	**195**
8	158	172	186	200	215	229	243	258	272	286	301	315	329	344	358														
9	125	136	147	158	169	181	192	204	215	226	238	249	260	272	283	294													
10	101	110	119	128	138	147	156	165	174	183	193	202	211	220	229	238	248	257											
11	83	91	99	106	114	121	129	136	144	152	159	167	174	182	189	197	205	212	220										
12	70	76	83	89	96	102	108	115	121	127	134	140	146	153	159	166	172	178	185	191									
13	60	65	71	76	81	87	92	98	103	109	114	119	125	130	136	141	147	152	157	163	168								
14	51	56	61	66	70	75	80	84	89	94	98	103	108	112	117	122	126	131	136	140	145	150							
15	45	49	53	57	61	65	69	73	77	81	86	90	94	98	102	106	110	114	118	122	126	130							
16	39	43	47	50	54	57	61	65	68	72	75	79	82	86	90	93	97	100	104	107	111	115	118						
17	35	38	41	44	48	51	54	57	60	63	67	70	73	76	79	83	86	89	92	95	98	102	105	108					
18	31	34	37	40	42	45	48	51	54	57	59	62	65	68	71	74	76	79	82	85	88	91	93	96	99				
19	28	31	33	36	38	41	43	46	48	51	53	56	58	61	63	66	69	71	74	76	79	81	84	86	89	91			
20	25	28	30	32	34	37	39	41	43	46	48	50	53	55	57	60	62	64	67	69	71	73	76	78	80	83			
21	23	25	27	29	31	33	35	37	40	42	44	46	48	50	52	54	56	58	60	62	64	67	69	71	73	75	77		
22	21	23	25	27	28	30	32	34	36	38	40	42	44	46	47	49	51	53	55	57	59	61	63	64	66	68	70	72	
23	19	21	23	34	26	28	30	31	33	35	36	38	40	42	43	45	47	49	50	52	54	56	57	59	61	62	64	66	
24	18	19	21	22	24	26	27	29	30	32	33	35	37	38	40	41	43	45	46	48	49	51	53	54	56	57	59	61	62

Color coding key:

Green = SDI zones 1 and 2 (15 to 35% of maximum SDI). This is considered the lower range of stocking.

Yellow = SDI zone 3 (36 to 45% of maximum SDI). This is considered the middle range of stocking.

Orange = SDI zone 3 (46 to 55% of maximum SDI). This is considered the upper range of stocking.

Red = SDI zone 4 (56% + of maximum SDI). Tree groups will not be managed within this zone.

Note: SDI "zones" are explained in the silviculture report.

Figure 74. Section E density management and stocking guidelines

Appendix E – Alternative B Through D Monitoring and Adaptive Management Plan

Introduction

Only key summaries from the comprehensive monitoring and adaptive management plan are included in the DEIS. Most details related to the multiparty monitoring plan have not been included in this summary. Multiparty monitoring is intended to meet the requirements of the Omnibus Public Land Management Act of 2009. This plan outlines who comprises the multiparty monitoring group and how the group works together to determine how data is collected, who will collect the date, where monitoring would occur, and how much monitoring will cost. The complete document can be accessed on the 4FRI Web site or in the project record.

The goal of this document is to (1) meet the Collaborative Forest Landscape Restoration Program (CFLRP) requirements for multiparty monitoring, (2) provide guidance for measuring physical and biophysical, social, and economic results of restoration activities across the initial 4FRI analysis area, and (3) provide a feedback mechanism that supports adaptive management. The information gained through monitoring would contribute to the science and practice of ecosystem restoration. In some cases, the results of this monitoring may not provide definitive answers to monitoring questions.

Types of Monitoring

Ecological monitoring is generally undertaken to determine whether the current state of the system matches or is trending toward some desired condition (Noon 2003). When conducted systematically, monitoring can provide valuable feedback regarding the effects of land management on resource conditions (Palmer and Mulder 1999, Lindenmayer and Likens 2010). Monitoring activities related to land management can be further classified into three categories: implementation, effectiveness, and validation (Busch and Trexler 2003). In addition to land management monitoring, monitoring is required per section 3 of the Comprehensive Forest Landscape Restoration (CFLR) Act (PL 111-11, Sec 4001, Omnibus Public Land Management Act of 2009).

Implementation monitoring is designed to determine the extent to which a management action was carried out as designed (did we do what we said we were going to do).

Effectiveness monitoring tracks the extent to which the management action achieved its ultimate objective. Effectiveness monitoring refers to an assessment of treatment effects, rather than to measuring whether they were applied as intended or whether they validate a pre-existing concept (e.g., did we increase heterogeneity).

Validation monitoring assesses the degree to which underlying assumptions about ecosystem relationships are supported (Block et al. 2001, Busch and Trexler 2003). Validation monitoring is most closely associated with research.

CFLR Act monitoring and reporting (required monitoring and reporting) includes: (1) a description of all acres treated and restored through projects implementing the strategy; (2) an evaluation of progress, including performance measures and how prior year evaluations have contributed to improved project performance; (3) a description of community benefits achieved, including any local economic benefits; and (4) the results of multiparty monitoring, evaluation, and accountability process. Items 1 through 3 are compiled locally and sent to the USDA Forest Service's Washington Office as part of the annual reporting requirement.

Monitoring Prioritization

Though financial resources (both Forest Service and stakeholder contributions) would be dedicated to monitoring, budgetary limitations would dictate how much and what type of monitoring can be accomplished. In order to help prioritize what monitoring would be accomplished, we prioritized monitoring using a tiered system (table 141). Tier 1 monitoring would take priority over Tier 2 and prioritization within each tier is expected. Research is independent of monitoring, will require funds in addition to this monitoring plan, and Forest Service approval may be required before research is initiated. However, the results of research would be considered during implementation and the adaptive management phase of the project.

Table 141. Monitoring plan tiers

Monitoring Tier	Priority for Completion	Who Will Complete	Type of Monitoring	Type of Funding
Tier 1	1	FS – Contractor	Implementation	Appropriated, Implementation
Tier 2	2	Multiparty FS Stakeholders Agency Partners	Effectiveness	Appropriated, Implementation, Partner
Tier 3	3	Multiparty FS Stakeholders Agency Partners	Effectiveness	Implementation, Partner
Research	No priority. Occurs as approved by forest supervisors.	Research Advocate	Implementation, Process, Effectiveness, Validation	Research Advocate, Partner

Monitoring Scales

Table 142 provides monitoring scales for the project. There are three sets of scales: scales designed to incorporate work completed by the 4FRI stakeholders, scales utilized in the EIS, and scales that tier directly to the forest plans. The stakeholder developed scales are intended to answer specific questions they may be interested in, the EIS scales are designed to provide information on movement toward the purpose and need, and the forest plan scales are designed to provide forestwide information that can be utilized in forest plan monitoring.

The scales developed by the stakeholder reflect the landscape strategy approach, which would monitor at the fine scale (group/site), at the mid-scale (site, treatment area), and at the landscape scale (treatment area, firescape, analysis area, and landscape).

For this analysis, the fine scale is the group or site, the mid-scale is the restoration subunit, and the landscape scale is the restoration unit and/or project area. These scales are typical of those used in forest management.

Table 142. Monitoring scales

Size (acres)	4FRI Stakeholder Landscape Strategy Scale	4FRI Coconino and Kaibab NF EIS	Coconino and Kaibab NF Forest Plans
<1	Group		Fine/Small
1–10	Site		Fine/Small
10–100	Site		Fine/Small
100–1,000	Site		Midscale
1,000–10,000	Treatment Area	Sub-unit	
10K–100,000	Treatment Area /Firescape	Restoration Unit	Landscape
100k–1,000 K+	Firescape, Analysis Area, Landscape	Analysis Area	Landscape

Monitoring Questions and Indicators

Quantitative measures have been used wherever possible, but many of the desired conditions are qualitative and generalized. As specific treatment-level desired conditions are developed, more specific monitoring methods may be incorporated. Scales of measurement in space (scale) and time (frequency) are proposed. Wherever feasible, monitoring is proposed at scales that are large enough to match the landscape approach of the project. For many variables, this could mean using landscape-scale, remotely-sensed data to gather comprehensive information, coupled with adequate ground sampling to verify image classification, develop predictive models, and measure variables that cannot be detected remotely. A very rough estimate of costs has been applied to some of the suggested indicators, but more detailed cost estimation would be needed as the monitoring designs become more specific.

Please note that desired conditions are grouped by theme (e.g., conservation of biological diversity) rather than by scale. Duplicative desired conditions were combined. Monitoring indicators and their associated details have been presented where possible. In some cases, the desired conditions are relatively general, context-dependent, related to policy or implementation rather than effectiveness or aspirational in nature. These cases are indicated with a combined single column that describes the issues associated with monitoring movement toward the desired condition. Table 143 is the implementation monitoring plan. Monitoring questions are largely grouped by treatment type or objective.

Table 144 displays the effectiveness monitoring plan. Additional monitoring questions that do not correspond directly to desired conditions are listed in appendices II to IV of the comprehensive plan (see project record). Table 145 displays effectiveness monitoring with specific trigger point and potential corrective actions related to various project elements.

Adaptive Management

Adaptive management refers to a “rigorous approach for learning through deliberately designing and applying management actions as experiments” (Murray and Marmorek 2003). Monitoring of alternative management actions provides the data for the adaptive management process. As a result of comparing monitoring results to the predicted outcomes, the plan provides a roadmap for adjusting actions or applying new science as long as the anticipated effects are within the scope of impacts analyzed and disclosed in the EIS and record of decision (ROD). Some of the effectiveness monitoring objectives have adaptive management actions that would be taken if the established thresholds are reached or exceeded. Alternatives B, C, and D have specific adaptive management actions for springs, channels, and roads that have been made part of the alternative (see DEIS chapter 2).

Table 143. Implementation monitoring questions, indicators, frequency of measurement, data source, and cost

Monitoring Questions Derived from Desired Condition	Monitoring Indicator	Frequency of Measurement	Data Source/Spatial Scale/Cost
Are ponderosa pine restoration treatments occurring within the project area?	Acres thinned /green tons removed, acres prescribed burned	Reported annually	Sale administration, USDA FS database of record/RU, forest/thinning cost calculation is determined by location of treatments and amount of service work completed; fire is calculated by individual fire and averaged by fire type.
Were mechanical treatments designed in accordance with the silvicultural implementation guide (see project implementation plan)?	Acres of treatment by treatment type (see project implementation plan for metrics)	Reported annually	Sale administration, USDA FS database of record/RU, forest/cost calculation are actual average cost for all grassland, oak, and aspen treatments by restoration unit.
Did treatments designed to naturalize nonsystem roads occur and were they implemented in accordance with design features, BMPs, and mitigation measures? Were adaptive actions utilized (alternative C)?	Miles of road effectively closed to motor vehicle traffic	Reported annually	Sale administration/RU/average cost of each treatment type by miles of actual treatment.
Did mechanical treatment and prescribed fire actions minimize soil loss and maintain long term soil productivity in compliance with forest plan standards?			
Did channel restoration treatments occur and were they implemented in accordance with design features, BMPs, and mitigation measures? Were adaptive actions utilized (alternative C)?	Miles and acres of channel restored	Reported annually	Sale administration, database of record RU/average cost per mile and acre.
Did treatments in MSO habitat occur and were they implemented in accordance to the project biological opinion?	Acres thinned/green tons removed, acres prescribed burned, acres burned in managed fire	Reported annually	Sale administration, USDA FS database of record/ RU, forest/thinning cost calculation is determined by location of treatments and amount of service work completed, fire cost is calculated by individual fire and averaged by fire type.

Monitoring Questions Derived from Desired Condition	Monitoring Indicator	Frequency of Measurement	Data Source/Spatial Scale/Cost
Were design features and mitigation followed and forest plan requirements met for threatened, endangered, sensitive species?		Reported annually	
Did actions minimize impacts to water resources in a manner that adheres to the Clean Water Act and the intergovernmental agreement between the Forest Service Southwestern Region, and the ADEQ?		Reported annually	
Did actions minimize the spread of noxious weeds in compliance with the forest plans (noxious weeds and special area guidance), FSM direction for noxious weeds and special areas (FSM 2090), FSM 2670 direction for sensitive plants, and the 1995 Arizona Bugbane Conservation Assessment and Strategy for the Coconino and Kaibab NFs?			
Did actions adequately protect Bebb's willow from fire and ungulate use in spring and riparian areas?			
Did actions minimize old and large tree mortality?			
Did actions result in acceptable old growth mortality in areas of concern (snags with known nests or roosts for herons, eagles, osprey, or other raptors and specific areas of old growth)?			
Did actions prevent damage or loss of infrastructure including historic range monitoring sites and allotment and pasture fences?			

Monitoring Questions Derived from Desired Condition	Monitoring Indicator	Frequency of Measurement	Data Source/Spatial Scale/Cost
Were planned prescribed fires coordinated with neighboring forests and other affected agencies and communities?			
Did emission mitigation techniques minimize smoke impacts to sensitive targets and Class 1 airsheds and meet ADEQ requirements?			
Did actions result in reduced crown fire potential and movement toward FRCC 1?			
Were scenery design features and mitigation measures incorporated into mechanical and prescribed fire treatments?			
Were cultural resource protection and mitigation measures incorporated into mechanical and prescribed fire treatments, and were the requirements of the Section 106 compliance report and the heritage protocol met?	Cultural resource sites protected	Post-project/task order review	Sale administration, USDA FS database of record, inspections by archaeologists

Table 144. Landscape-scale effectiveness desired conditions, indicators, frequency of measurement, data source, and cost

Effectiveness Monitoring Desired Conditions	Monitoring Indicator (Tier 1, Tier 2)	Frequency of Measurement	Data Source/Spatial Scale/Cost
Conservation of Biological Diversity			
Ponderosa pine ecosystems provide the necessary composition, structure, abundance, distribution, and disturbance processes that contribute to the diversity of native plant and animal species at the project landscape scale.	Tier 1: Landscape-scale coverage of forest variables: composition, structure, spatial pattern	Annually	Remote sensing (RS) verified by ground sampling/landscape scale/RS data are free but analysis is $15,000 per event, ground plots $2,000 per plot to install, $1,000 per plot re-measure.
Ponderosa pine ecosystems are composed of all age and size classes within the analysis area and are distributed in patterns consistent with the natural range of variability.	Tier 1: Age Structure: tree diameter distribution (note that d.b.h. is only a surrogate for age)	Immediately post-treatment and every 5 years	Remote sensing verified by ground sampling of tree point or canopy area pattern (maps)/landscape scale/RS data are free, ground plots $40,000 to develop spatial model; analysis $5,000 per event.
Ponderosa pine ecosystems are heterogeneous in structure and distribution at the analysis area. Openings and densities vary within the analysis area to maintain a mosaic appropriate to support resilience of individual trees and groups of trees.	Tier 1: Spatial pattern of tree groups (requires specific thresholds for spatial statistics) using Ripley's K and/or Getis/Ord Tier 1: Canopy openness – percent and characteristics of openings	Immediately post-treatment and every 5 years	Remote sensing verified by ground sampling of tree point or canopy area pattern (maps)/landscape scale/RS data are free, ground plots $40,000 to develop spatial model; analysis $5,000 per event
NFMA stocking requirements	Tier 1: Stocking requirements are met in acres managed for regeneration. If the areas do not meet desired stocking after 5 years, conditions that are inhibiting regeneration will be identified and remedial action may be prescribed to ensure regeneration.	At 5 years	Walk-through reforestation certification exam at year 5 post treatment/RS data are free, ground plots $40,000 to develop spatial model; analysis $5,000 per event.
Natural and prescribed fires support diverse native understory communities and their associated biodiversity. Understory vegetation composition and abundance are consistent with the natural range of variability.	Tier 1: Understory vegetation diversity (percent change in cover/bare ground, percent change in high-risk invasive species)	Every 5 years	Ground plots/stand scale/sample strategically to minimize cost, ground plots $2,000 per plot to install, $1,000 per plot re-measure.

Effectiveness Monitoring Desired Conditions	Monitoring Indicator (Tier 1, Tier 2)	Frequency of Measurement	Data Source/Spatial Scale/Cost
Forest conditions facilitate species' movement to and from adjacent landscapes, ecosystems, or habitats.	Tier 1: Spatial analysis of patches (patch area, density, size distribution), corridors, fragmentation, model movement	Every 10 years	Nearest neighbor distance distribution, Contagion, Simpson's Diversity, and Evenness Indices Remotely sensed data/landscape scale/RS data are free, ground plots $40,000 to develop spatial model. Analysis $5,000 per event.
	Tier 2: Songbird species richness: presence/absence Jackknife 2, Chao 2, ICE Species Richness Estimator	Immediately post-treatment and every 2 years thereafter	
Ecosystem Resilience			
A majority of the ponderosa pine ecosystems supports frequent, low-intensity fire.	Post-treatment fuel measurements (CBD, CBH, acres with crown fire potential, acres with surface fire potential, acres of FRCC 1 to FRCC 3)	Annually	No numbers provided.
Water and Air Resources			
Soil productivity, watershed function, and air quality are not at risk of being degraded by uncharacteristically severe disturbances (e.g., landscape-scale, high-severity fire).	FRCC reporting	Annually	No numbers provided.
Springs and associated streams and wetlands have the necessary soil, water, and vegetation attributes to be healthy and functioning at or near potential. Waterflow patterns, recharge rates, and geochemistry are similar to historic levels and persist over time. Water quality and quantity is maintaining native aquatic and riparian habitat and water for wildlife. Designated beneficial uses are consistent with water rights and site capability. Plant distributions and occurrences resilient to natural disturbances. Associated soils are in satisfactory condition.	Tier 1: Changes to the extent of soil saturation or standing water are apparent, taking into consideration the setting and site potential. Changes to the abundance and extents of plants that are obligate wetland and/or facultative wetland species, taking into consideration the setting and site potential Changes to the site that indicate management induced sediment delivery to springs and associated streams and wetlands that indicate soil erosion above tolerance thresholds	Every 5 years	Groundwater Dependent Ecosystems: Level 1 Inventory Field Guide, Inventory Assessments for Field Planning. (Gen. Tech. Report WO-86a). pgs. 35-103.

Effectiveness Monitoring Desired Conditions	Monitoring Indicator (Tier 1, Tier 2)	Frequency of Measurement	Data Source/Spatial Scale/Cost
	Exclosure fencing is protecting the site from adverse impacts caused by ungulate herbivores.		
Emissions factors, smoldering and smoke residence are reduced as fires burn more grass and less green or woody biomass over time.	Smoke emissions by acres burned	Annually	No numbers provided
Economics			
The byproducts of mechanical forest restoration offset the costs of treatment implementation. The average net cost of treatment per acre is significantly reduced over the 10-year period.	Exchange of goods for services contract reporting	Annually	No numbers provided.
The economic value of ecosystem services provided by restored forests are realized and reinvested to support forest restoration and ecosystem management.	Exchange of goods for services contract reporting	Annually	No numbers provided.
Rural communities receive direct and indirect economic benefits.	CFLR business model report	No number provided	No number provided.
Sufficient harvest and manufacturing capacity exists to achieve restoration of at least 300,000 acres in the next 10 years.	Estimate of harvesting and utilization capacity	Every 5 years	Government records, inference from response to contracts, expert opinion.
Social Systems			
There is broad public support or acceptance of collaboratively-based forest restoration decisions, processes, and outcomes, including the use of fire as a management tool.	Public support/concerns assessed	1. Pre- and post-treatment 2. Pre- and post-education/outreach program delivery	Interviews with land managers and focus groups with community members to assess specific issues and concerns, used to develop telephone survey questions/data analyzed: short-term: within analysis area; long-term: across the four forests/$30,000 each pre- and post-measures per analysis area.

Effectiveness Monitoring Desired Conditions	Monitoring Indicator (Tier 1, Tier 2)	Frequency of Measurement	Data Source/Spatial Scale/Cost
Social values and recreational opportunities are protected or enhanced through forest restoration activities.	Social values and recreational opportunities assessed	1. Pre- and post-treatment 2. Pre- and post-education/outreach program delivery	Targeted focus groups (two per organization) aimed at specific user groups (hunters, hikers, ORV, etc.) and/or telephone survey with general public/Data analyzed: short-term: within analysis area; long-term: across the four forests/Focus groups: $5,000 to $10,000 per organization; telephone survey (cost as above).
Rural communities are protected from high-severity fire and their quality of life is enhanced through forest restoration.	1. Frequency and acreage of high-severity fire in and around rural communities 2. Quality of life assessed	1. As projects are completed around communities. 2. Pre- and post-treatment 3. Pre- and post-education/outreach program delivery	1. USDA FS wildfire database/within analysis area (short-term); across the 4FRI area (long-term)/$500 per analysis area. 2. Telephone survey (cost as above).
Rural communities play an active part in reducing fire risk by implementing Firewise actions and creating defensible space around their property.	1. Number of households/neighborhoods that are implementing (the degree of) Firewise principles 2. Number of communities in the analysis/4FRI area	1. Pre- and post-treatment 2. Pre- and post-education/outreach program delivery	1. Telephone survey (cost as above) 2. Interview fire station personnel in neighborhood/home assessments and/or review fire station field.
Treatments within the analysis area minimize short-term impacts and enhance vegetation characteristics valued by forest users over the long term.	Forest user perceptions of treatments within the analysis area	1. 1 year post-treatment 2. 5 years post-treatment	Multiple field trips with forest users (random selection of participants to adequately represent general public)/analysis area/$5,000.

Effectiveness Monitoring Desired Conditions	Monitoring Indicator (Tier 1, Tier 2)	Frequency of Measurement	Data Source/Spatial Scale/Cost
There is low potential for fires to enter communities. Communities and homeowners are prepared for the undesirable case that fires that do enter communities.	1. Fire modeling 2. Number of households and neighborhoods implementing Firewise principles	1. Pre- and post-treatment in WUI communities 2. Pre- and post-education/outreach program delivery	1. 4FRI Science and Monitoring Working Group/communities within analysis area 2. Telephone survey (cost as above). 3. Interview fire station personnel in neighborhood/home assessments and/or review fire station field survey logs/$2,000 to $5,000. 4. Number of neighborhoods certified through Firewise/Communities/USA/$500.
Fire management costs are reduced; aggressive fire suppression is unneeded or rare.	1. Forest Service fire suppression costs 2. Number and acreage of USDA FS suppressed wildfires	Every 10 years	Forest Service records. National Interagency Fire Center records on wildfire occurrence/Analysis area/$1,000.
Heritage Resources			
Cultural resources are not at risk of being degraded by uncharacteristically severe disturbances (e.g., landscape-scale, high-severity fire and soil erosion).	Post-treatment fuel measurements on cultural resource sites	As projects/task orders are completed	No numbers provided.

Table 145. Effectiveness monitoring plan

Desired Condition	Indicator	Metric	Method and Sampling Technique	Scale	Trigger (Threshold Indicating Possible Need for Change)	Adaptive Action
There is reduced potential for introduction, establishment, and spread of invasive species. Existing infestations are reduced.	Invasive plants	Species cover	Field/RS	Site, SU, RU analysis area, landscape	High risk species are not reduced by 50% post-treatment over pre-treatment data within 2 years	Discontinue treatment until alternative approach is development
					Watch list species are not reduced by 90% within 1 year post-treatment	Prohibit mechanized harvest and/or other activities contributing to spread
					Target invasive species are not reduced by 20 % within 5 years	Discontinue treatment until alternative approach is development
		Cheatgrass			Cheatgrass increases above pre-treatment condition	Discontinue treatment in adjacent high risk areas until alternative approach is developed
Ponderosa pine ecosystems provide the necessary composition, structure, abundance, distribution, and disturbance processes that contribute to the diversity of native plant and animal species including common, listed, rare, and sensitive species.	Diversity (wildlife communities)	Songbird species richness	Field (RMBO songbird surveys), RS, modeling	Measured at (1-km point grid) site, SU, RU, analysis area, landscape	5 year decrease in closed canopy, open canopy, and pine-sage species at the treatment area or larger scale	**Closed canopy species:** Increase group size for all treatments (based on ADGF experiment) Reduce intensity of all UEA 40–55 treatments Identify 25% of planned UEA 40–55 treatments and reduce intensity to 25–40

Desired Condition	Indicator	Metric	Method and Sampling Technique	Scale	Trigger (Threshold Indicating Possible Need for Change)	Adaptive Action
						Open canopy species: Increase the size of openings in all treatment types Identify 25% of planned UEA 25–40 treatments and increase intensity to 40–55% **Pine-sage species:** Alter timing of treatment to reduce impacts on sage. Delay post-treatment burning to allow sage recover.
Forest conditions facilitate species' movement to and from adjacent landscapes, ecosystems, or habitats.		Changes in landscape connectivity and permeability	Movement data from transmitted black bear OR grey fox (to represent denser forest conditions) and pronghorn (to represent more open forest condition	RU, Landscape	Restriction of bear/fox movements (reduced connectivity between patches of untreated, higher density, or pine-oak) when comparing pre- to post-treatment. No increase in pronghorn movement when comparing pre- to post-treatment	Increase group size, decrease treatment intensity within known pathways Increase opening percentage Increase treatment intensity within known pathways
		Northern goshawk	Utilize existing framework from USDA FS National Guide-lines, with	RU, Landscape	Trigger points will be assessed as data from Kaibab NF monitoring plan becomes available	Dependent on trigger points and data availability.

Desired Condition	Indicator	Metric	Method and Sampling Technique	Scale	Trigger (Threshold Indicating Possible Need for Change)	Adaptive Action
			proposed modify-cations developed by Kaibab NF staff and LLECB (B. Dickson)			
Understory vegetation composition and abundance are consistent with the natural range of variability.	Diversity (understory communities)	Percent cover native species	Field collected - quadrats	Site, SU, RU	Within 5 years of mechanical treatment, change in cover should be 20 (+/-5)% (15–25%) above controls (Laughlin et al. 2011)	If this threshold is not reached, then reevaluate treatment for management change, taking into account soils and burn treatment, e.g., reduce overstory basal area.
		Percent bare soil within treatment blocks	Field collected - quadrats	Site, SU, RU	Within 5 years of treatment (mechanical and/or fire), bare soil should comprise less than 30% of area affected by treatment.	If bare soil exceeds 30% of area within plots, reevaluate restoration treatment for modification.
		Seedlings and saplings	Field collected - quadrats	Site, SU, RU	Within 10 years of treatment, seedling, and sapling density should be within 0.4 to 3.6 plants/hectare/decade on basalt soils (Mast et al 1999)	If seedlings and saplings fall below this range across sub-units where regeneration is a desired condition, then evaluate implementation of BMPs to increase probability of successful regeneration. If regeneration falls above this range, then

Desired Condition	Indicator	Metric	Method and Sampling Technique	Scale	Trigger (Threshold Indicating Possible Need for Change)	Adaptive Action
						more aggressive prescribed burning may be necessary to reduce plant density.
A majority of the ponderosa pine ecosystems supports frequent, low-intensity fire. There is low potential for unnaturally severe fire to spread across the restoration unit.	Potential fire behavior	Crowning index, torching index, rate of spread	RS and modeling	RU	% of 4FRI veg types with passive or active crown potential <25% after first 5 years and < 10% after 10 years.	Reevaluate potential causes: acres treated and/or treatment prescriptions.
					Patch size of adjacent pixels expressing stand replacement fire sizes: max size 50 acres for first 5 years and max size 10 acres after 10 years.	
Cultural resources – implementation monitoring	Cultural resources condition surveys and/ or damages incurred during implementation	Change in condition of cultural resources	Site visitation post project/task order implementation Discovery of new sites during implementation	Cultural resource property	Cultural resources damaged during implementation	Reevaluate potential causes: acres treated and/or treatment prescriptions, site protection measures implemented, site boundary markings

Appendix F – Cumulative Effects

A summary of past, present, and reasonably foreseeable management actions and natural disturbances are presented here. See the project record for the comprehensive master list of all projects for additional information on each project. Electronic maps that display much more detail are available on the project's Web site or upon request.

Authorized Livestock Management

The information found in this section has been summarized from the range specialist report (Hannemann 2013). It is incorporated by reference. Livestock grazing has occurred on the project area at least since the 1800s. Livestock (sheep and cattle) grazing can be traced back to the 1800s when roads within the forests were used to drive herds between New Mexico and California. By the early 1890s, overgrazing had resulted in changes to understory vegetation by reducing grasses and forbs. By the 1970s, the forests had assigned livestock numbers to allotments and rangeland improvements had been put in place to improve livestock distribution and avoid overutilization on sensitive areas (such as riparian). In 1987 and 1988, the forests' land management plans were put in place addressing grazing capacity and utilization.

Historic range monitoring data for the project area was reviewed in 2011 (Brewer 2011). Data indicates cool season species increased through the 1990s in response to an increase in cool season moisture. In the last 10 plus years, decreased cool season moisture and increased warm season moisture has increased warm season species like blue grama. Today, excessive tree density (related to past land management practices) is causing a plant conversion to more shade tolerant species (such as bromes and mountain muhly).

Timber Harvest

Information on past timber harvests is summarized from the silviculture specialist report and is incorporated by reference (McCusker 2013). Past timber harvest practices influenced vegetation structure, pattern, and composition on about 90 percent of the project area. From the late 1880s to the 1940s, logging that facilitated construction of the railroads was conducted by several lumber and timber companies in the Flagstaff and Williams area (McCusker 2013). By 1940, the railroads had removed all the profitable lumber that could be easily accessed. In terms of vegetation structure, the largest and oldest tree sizes (VSS 5 and VSS 6) were removed from the project area (and across the forests in general). Extensive regeneration with no large trees interspersed within the younger age classes became the norm. The pattern on the landscape no longer resembled the historic condition with historic tree groups and patch sizes ranging from 0.1 to 0.75 acre in size and with 2 to 40 or more trees (White 1985).

Past timber sales within the project area such as the 49'er, El Paso (1991), and Moritz sales (1985), all implemented prior to the Southwestern Region's 1996 amendment of forest plans, targeted the harvest of medium and large diameter trees. In some cases, all trees over 12 inches in diameter were removed. This affected the presence of pre-settlement trees. Today, at the landscape (project area) scale, they are rare.

The focus on even-aged forest management continued until the mid-1990s, leaving the legacy of current forest conditions. Approximately 50 percent of the project area that received some type of regeneration or shelterwood harvest has regenerated. Many stands are even-aged, dense, and lack age class diversity. Today, at least 83 percent of goshawk non-PFA habitat vegetation structural stage 3 (young-aged forest) and 4 (mid-aged forest) is even-aged. Approximately 74 percent of the project area is classified as having moderately closed to closed tree canopies (4FRI Proposed Action 2011). Figure 75 displays the general location of past vegetation projects that occurred prior to 1996.

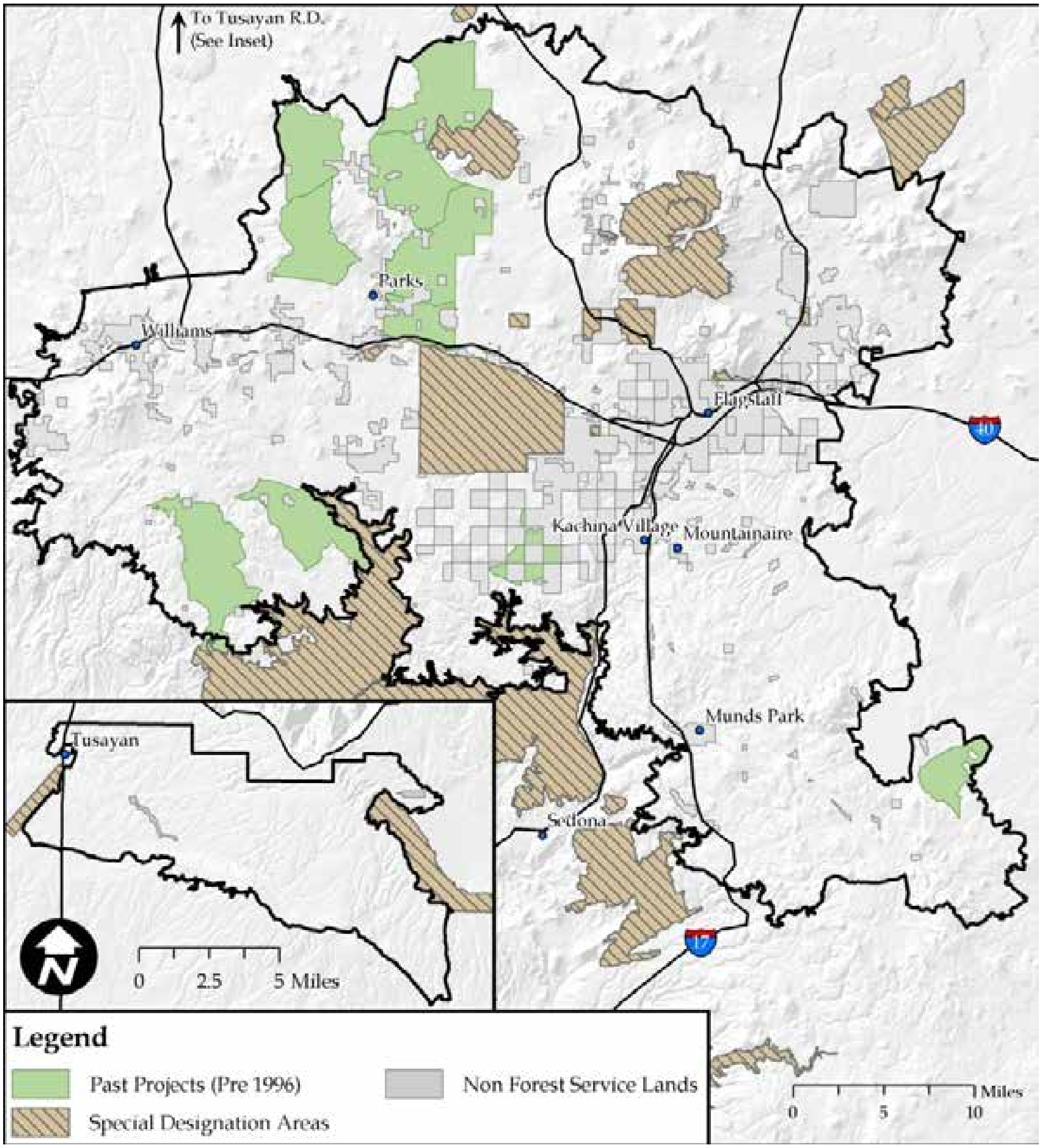

Figure 75. Pre-1996 vegetation and prescribed fire projects within the project area

Post-1996 Vegetation Treatments – Uneven-aged Management, Fire Risk, Restoration

After the region-wide 1996 amendment, vegetation objectives included uneven-aged management. A review of the FACTS timber database indicates that treatments designed to promote uneven-aged management began being recorded in 1991 on the Kaibab NF and as early as 1987 on the Coconino NF. However, acres treated in this category continued to be minor in comparison to acres treated with even-aged methods until about 2005 (McCusker 2012).

After 1996, the objective of most vegetation projects in the project area was to reduce the risk of high-severity fire, improve forest health (stand and tree resilience and vigor), and improve understory diversity. Retention of snags and managing for coarse woody debris was further enhanced with the 1996 amendment and made part of project requirements.

The 1996 forest plan amendment also changed treatments in Gambel oak and the species was recognized for its role in managing for ecological diversity and high quality wildlife habitat. From 1996 to 2000, at least seven projects (Spring Valley WUI, Upper Basin, Marteen, Ten X and Red Horse Mudderbach, Elk Lee, Beacon, and Parks) totaling 30,000 acres on the Kaibab NF, were treated with objectives including reduced fire risk, savanna and meadow restoration, oak improvement, improved age class structure and diversity, and to maintain industry.

On the Coconino NF, at least 68,800 acres were planned for treatment for similar purposes (Fire Data FY96 to FY99, 2011). Large projects on the Coconino NF that addressed fire risk included Mint Spring (7,778 acres of mechanical and 12,000 acres of prescribed fire, 1998) and the A-1 project (14,500 acres with mechanical and broadcast prescribed fire, 2000).

With the exception of those projects that removed large, old trees and promoted even-aged management, most vegetation projects that contributed to the current condition within the project area occurred from 2000 to 2010 (or 2011 if data was available). Since 2000, most vegetation project objectives have included reducing fire risk to communities, improving wildlife habitat in sagebrush (Tusayan district, Kaibab NF) and grasslands, improving winter range wildlife habitat, and improving forest health and diversity (moving toward a balance of age classes, reducing mistletoe infection, promoting growth in old, large ponderosa pine, promoting aspen, and restoring ponderosa pine savanna conditions).

On the Coconino NF, projects designed primarily to address fire risk in the project area include Rocky Park Fuels Reduction (13,651 acres, 2001), Kachina Village (11,029 acres, 2003), and Mormon Lake Fuels Reduction (2,388 acres, 2005). Similar projects on the Kaibab NF include Williams High Risk Precommercial Thin (756 acres, 2001), Dogtown Fuels Reduction (8,209 acres, 2004), and Pineaire Fuels Reduction (650 acres, 2004).

Since 2000, at least 6,149 acres have been mechanically treated and prescribed burned on the Kaibab NF to improve wildlife habitat, and 2,485 acres have been treated to improve/restore grasslands. Wildlife habitat improvement projects included Potato Hill Habitat Improvement Project (1,275 acres, 2003), Upper Basin Project (1,884 acres, 2000), and Moqui Antelope Habitat Improvement Project (2,990 acres, 2006). Grassland restoration projects included Garland Prairie (500 acres, 2005), Ida Grassland Restoration (1,800 acres, 2008), and Community Tank Grassland Restoration (185 acres, 2011). On the Coconino NF, almost 7,000 acres have been treated to directly improve wildlife habitat (habitat improvement was the treatment objective). Some of the larger projects (within the project area) on the Coconino NF designed to restore grasslands, woodlands, and wildlife habitats include Hart Prairie Fuels Reduction (9,815 acres, 2010), Elk Park Fuels Reduction (11,100 acres, 2007), and the Slate Mountain Pronghorn Project (2,250 acres, 2010). Projects adjacent to, but outside of, the project area include the Anderson Mesa Project.

Since 2000, over 13,829 acres of treatment on the Kaibab NF have focused on forest health and diversity objectives. Projects include Frenchy (9,319 acres of thinning that include savanna and meadow restoration and prescribed burning, 2003). On the Coconino, projects that addressed fire risk but also included restoration objectives such as meadow, riparian, and grassland restoration include Fort Valley (1,700 acres, 2000), Apache Maid Grass (54,528 acres, 2004), and Woody Ridge (8,599 acres, 2004).

However, even some of the most recent tree thinning projects (2000 to present) have focused thousands of acres of treatment on the removal of the smallest trees. Some of these treatments were limited in order to comply with the forest plans when treating in MSO protected and restricted habitats. This has produced results similar to treatments conducted in the 1980s – rapid regeneration and high tree density. Projects that focused on removing only the smallest trees (usually up to 9-inch d.b.h.) were primarily focused on reducing fire risk adjacent to public areas such as residential areas and campgrounds. Available data was reviewed and assumptions were made on some projects where data was incomplete.

From 2000 to 2010 on the Kaibab NF, about 3 percent of the project area (of the 596,000 acres proposed for treatment) was treated in a manner that resulted in prolific regeneration.

On both forests, vegetation projects have typically included the construction (and decommissioning) of temporary roads and have decommissioned roads (Fleishman et al. 2013). Since 2000, approximately 47 miles of temporary road have been constructed (and decommissioned), 251 miles of existing road have been decommissioned (117 miles on the Kaibab NF and 44 miles on the Coconino NF), and approximately 1 mile has been relocated to reduce impacts on resources. Table 146 displays projects that have influenced the existing condition. Figure 76 displays the general location of projects post-1996.

Table 146. Summary of past vegetation and prescribed fire project acres (2000 to 2010)

Project Name	Year (NEPA Decision)	Treatment Type	Acres* Mechanical /Prescribed Fire	Forest/District	
				Coconino	Kaibab
Williams High Risk	2001	Mechanical treatment and pile burn	756/756		Williams
Potato Hill	2003	Mechanical treatment, lop and scatter	1,275/0		Williams
Frenchy	2003	Mechanical treatment and pile burn	9,319/9,319		Williams
Dogtown	2004	Mechanical treatment and pile burn	6,509/6,509		Williams
Clover High	2004	Mechanical treatment and pile burn	385/385		Williams

Project Name	Year (NEPA Decision)	Treatment Type	Acres* Mechanical /Prescribed Fire	Forest/District	
				Coconino	Kaibab
Pineaire	2004	thin and prescribe, pile burn	650/650		Williams
Williams Followup Mistletoe	2004	Mechanical treatment and pile burn	368/368		Williams
Government Mountain/Coleman	2005	Mechanical	75/0		Williams
Garland Prairie	2005	Mechanical treatment and lop, pile burn	500/47		Williams
City	2005	Mechanical treatment and pile burn/ prescribed fire	8,667/12,400		Williams
Kendrick	2005	Mechanical treatment and prescribed fire	Unknown		Williams
Flag Tank	2007	Mechanical treatment and prescribed fire	22/36		Williams
IDA Grassland	2008	Mechanical treatment and prescribed fire	1,800/1,800		Williams
Bill Williams Cap	2009	thin and prescribe burn	10/10		Williams
Community Tank	2011	Mechanical treatment and prescribed fire	185/185		Williams
Upper Basin	2000	Prescribed fire	0/1,884		Tusayan
Tusayan West	2001**	Mechanical treatment and prescribed fire	549/850		Tusayan
Tusayan South/Boggy Tank	2000–2002	Mechanical treatment and prescribed fire	2,948/2,948		Tusayan
Ten X	2004	Mechanical treatment and prescribed fire	1,780/700		Tusayan
Topeka	2004	Mechanical treatment and prescribed fire	1,100/1,100		Tusayan
Moqui Antelope	2006	Mechanical	2,990/2,990		Tusayan

Project Name	Year (NEPA Decision)	Treatment Type	Acres* Mechanical /Prescribed Fire	Forest/District	
				Coconino	Kaibab
Scott	2001	Mechanical, pile, and prescribed fire	721/9,434		Tusayan
X Fire	2009	Mechanical	140/0		Tusayan
O'Connell	< 2009	Mechanical	500/0		Tusayan
Arboretum WUI	2000	Mechanical treatment and prescribed fire	602/602	Flagstaff	
Fort Valley	2000	Mechanical	1,700/0	Mogollon Rim/Flagstaff	
A-1 East, West	2000	Mechanical, pile, and prescribed fire	5,517/8,638	Flagstaff	
Rocky Park	2001	Mechanical treatment and prescribed fire	5,651/8,000	Flagstaff	
Lake Mary	2005	Mechanical treatment and prescribed fire	1,845/3,245	Flagstaff	
APS Hazard Tree	2003	Prescribed fire	0/315	Flagstaff	
APS Powerline	2007	Mechanical	167/0	Flagstaff	
Blue Ridge 69kV	2005	Mechanical treatment and prescribed fire	50/1,300	Mogollon Rim	
Doney Park 69kV	2007	Mechanical	9/0	Flagstaff	
Kachina Village	2003	Mechanical treatment and prescribed fire	3,801/2,147	Flagstaff	
Apache Maid Grass	2004	Mechanical	54,528/0	Mogollon Rim	
Woody Ridge	2004	Mechanical treatment and prescribed fire	7,987/11,184	Flagstaff	
Mormon Lake	2005	Mechanical treatment and prescribed fire	2,388/2,388	Flagstaff	
Skunk Canyon	2005	Prescribed fire	0/831	Flagstaff	
Elden	2006	Mechanical	193/0	Flagstaff	
Eastside	2006	Mechanical treatment and prescribed fire	7,819/20,197	Flagstaff	

Project Name	Year (NEPA Decision)	Treatment Type	Acres* Mechanical /Prescribed Fire	Forest/District	
				Coconino	Kaibab
East Clear Creek	2006	Mechanical treatment and prescribed fire	83/14,500	Mogollon Rim	
Elk Park	2007	Mechanical treatment and prescribed fire	1,800/3,500	Flagstaff	
Little Draw Aspen	2009	Mechanical	107/0	Flagstaff	
Munds Park	2009	Mechanical treatment and prescribed fire	990/2,950	Flagstaff	
Slate Mountain	2010	Mechanical	2,250/0	Flagstaff	
Schultz Fire BAER	2010	Mechanical (snag removal)	150 snags removed/0	Flagstaff	
Acre Summary					
Total mechanical/vegetation treatment acres			**138,736 acres**		
Total prescribed fire acres			**132,168 acres**		

*Some projects are still in the implementation phase. Acres included here only include acres that have been implemented.
**The decision for Tusayan West was 1998 and implementation was 2001.

Table 147 lists projects that are outside but adjacent to the project area.

Table 147. Summary of past vegetation and prescribed fire project acres (2000 to 2010) adjacent to the project area

Project Name	Year (NEPA decision)	Treatment Type	Acres Mechanical/ Prescribed Fire	Forest/District	
				Coconino	Kaibab
Williams High Risk	2001	Mechanical treatment and pile burn	756/756	data not available	Williams
Potato Hill	2003	Mechanical, lop and scatter	1,275/0	data not available	Williams
Frenchy	2003	Mechanical treatment and prescribed fire	9,319/9,319	data not available	Williams
Dogtown	2004	Mechanical treatment and prescribed fire	6,509/6,509	data not available	Williams
Acre Summary					
Total mechanical/vegetation treatment acres			**17,859 acres**		
Total prescribed fire acres			**16,584 acres**		

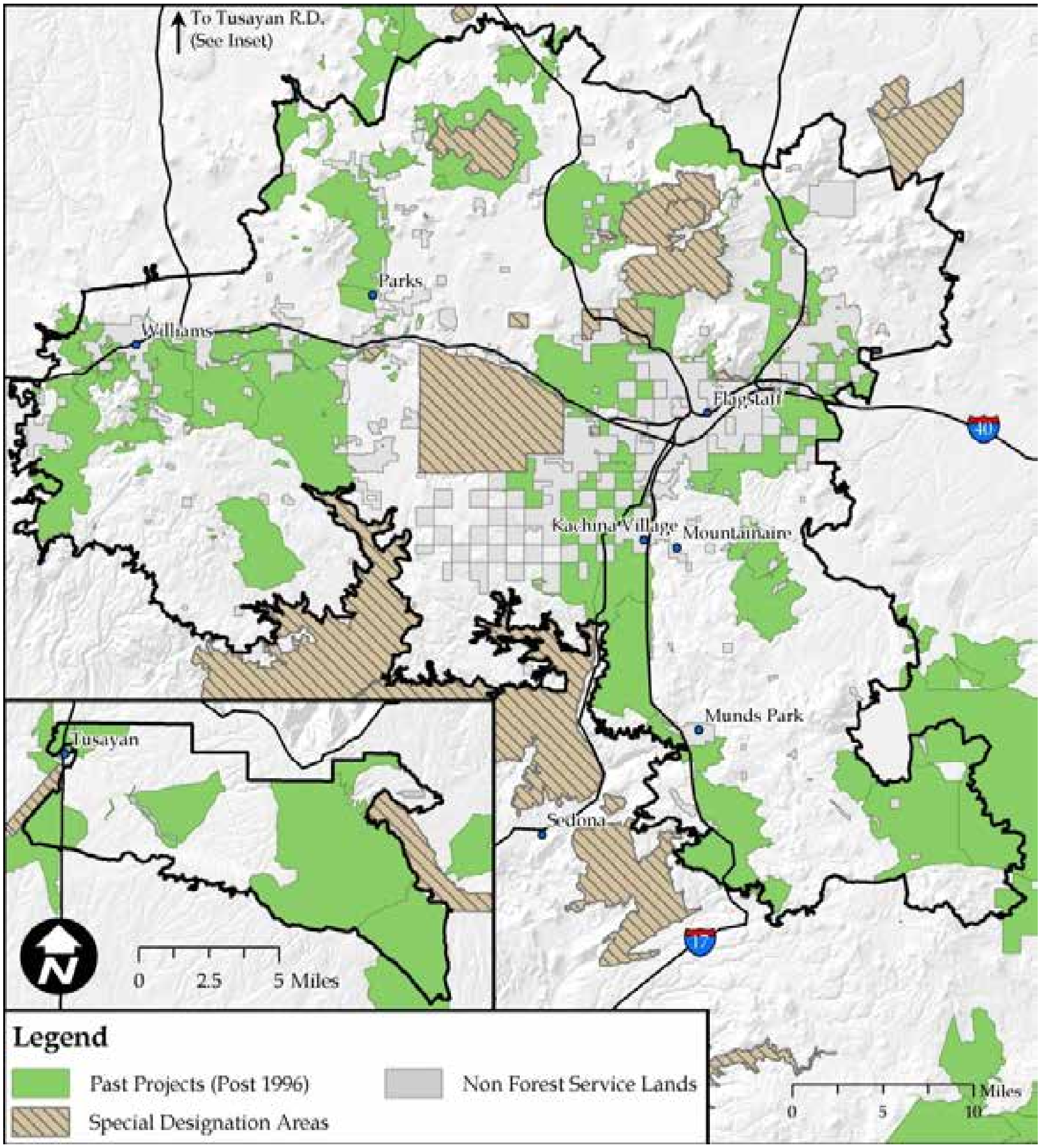

Figure 76. General locations of past projects (post-1996) within the project area

Natural Disturbances – Fire[12]

Information on natural disturbances (fire) is summarized from the fire ecology specialist report (Lata 2012) and the report is incorporated by reference.

Most of the vegetation types on the Kaibab and Coconino NFs are adapted to the frequent, low-intensity fire that occurred periodically prior to Euro-American settlement. In fire-adapted

[12] Please note, the fire ecology report also considered projects outside of the project area. For this reason, the project list may vary.

vegetation types, ecosystem function is dependent on this regular disturbance. However, ceasing all fires was common practice, dating back to the late 1800s and mid-1900s. During this time, extensive livestock grazing consumed the abundant grasses with forest reserve management plans often urging heavy grazing to eliminate the herbaceous fuels that allowed surface fires to sweep across the land (Drake 1910). In addition to grazing, early settlers also suppressed fire to protect their livelihood and homes.

Organized fire suppression efforts by the Forest Service date back to the first decade of the 20th century, largely in response to unacceptable fire effects due to heavy slash loads left by railroad logging. In 1935, the Forest Service further instituted a policy that all fires were to be extinguished by 10 a.m. of the day following their detection (Pyne 1982). Throughout most of the 20th century, foresters continued to extinguish all fires regardless of ignition cause, intensity, or degree of danger to human safety or property. Widespread fire suppression efforts continue and a high percentage of Federal resources are focused on suppression (Covington 2003).

As noted in the vegetation management section, without fire, understory seedlings in pine and mixed conifer forests had unprecedented survival rates. White fir, Douglas-fir, and even Engelmann spruce seedlings became established under ponderosa pine stands. Juniper and pinyon seedlings invaded former grassland savannas. The increase in tree density and resulting buildup of woody fuels led to unnaturally large and severe wildfires, insect outbreaks, and reduced biodiversity (Friederici 2004).

Data on wildfire acreages from 1940 to 1970 was derived from Covington 2003. Data on past wildfires that have occurred within the project area from 1970 to 2010 was derived from the project's fire ecology specialist report. Data was compiled using a Forest Service database query, Fire Family Plus, for those districts of the Coconino and Kaibab NFs that are located south of the Grand Canyon in (largely) ponderosa pine vegetation. Acres may include portions of some pinyon-juniper and some mixed conifer vegetation. In addition to this data, each forest's FACTS database was accessed to provide a subset of individual fires and acres for each forest (Latta 2013).

Table 148. Coconino and Kaibab NF wildfire acres 1940 to 2010

Time Period	Project Area Wildfire (acres affected)
1940–1960	10,139 (Coconino NF only)
1960–1969	1,090 (Coconino NF only)
1970–1980	49,631
1981–1990	7,399
1991–2000	63,397
2001–2010	180,499
Total acres	**312,155**

Table 148 summarizes (estimates) acres of wildfire since 1940. Overall, wildfire has influenced at least 18 percent of the project area since 2001. Severe effects associated with past wildfires are attributed to 20 to 30 percent (of the 18 percent) of the area burned within the project area. These fires affected structure, pattern, composition, and function by creating an even-aged plantation-type tree structure with grass and brush that are no longer contributing to a forested structure. The remaining 70 percent of fires were low- to mixed-severity fires that provided beneficial impacts. These events affected structure, pattern, composition, and function by returning fire—a natural process—to the ponderosa pine system.

As noted in table 146 and table 147, thousands of acres in and adjacent to the project area have been (or are currently being) treated to reduce hazardous fuels. Vegetation was thinned and residual slash reduced/removed through various methods including machine pile and burn, hand pile and burn, chipping, lop and scatter, mastication, and mowing. From 2000 to 2010, at least 56,146 acres on the Williams and Tusayan districts were treated to reduce hazardous fuels. On the Coconino NF, at least 83,979 acres[13] were treated within the project area to address hazardous fuels.

Natural Disturbances – Insect and Disease

Information on natural disturbances (fire) is summarized from the silviculture specialist report (McCusker 2013) and the report is incorporated by reference.

The Coconino NF experienced significant bark beetle outbreaks in the mid-1920s, late 1930s, mid-1960s, late 1970s through early 1980s, and late 1990s through the mid-2000s. The 1950s and 2000s outbreaks appear to be more extensive than other outbreaks, damaging at least 200,000 and 72,000 acres, respectively. Ponderosa pine needleminer defoliated over 9,000 acres of ponderosa pine on the Coconino NF in 1999 (USDA Forest Service 2000).

On the southern portion of the Kaibab NF, western pine beetle activity was reported in late 1970s and early 1980s. The contemporary (2000s) bark beetle outbreak is probably more severe than past outbreaks. Ponderosa pine mortality approached 100 percent in some stands (Gitlin et al. 2006), but averaged only 3.4 percent in a limited number of plots distributed across Williams Ranger District (RD) and Tusayan RD (Negrón et al. 2009).

Southwestern dwarf mistletoe is dispersed throughout the project area where 2 to 31 percent of the commercial ponderosa pine type was infected in the 1980s on the northern half of the Coconino NF, and 25 to 38 percent of the commercial ponderosa pine type was infected on the Williams district (Hessburg and Beatty 1985).

Annual aerial surveys on the Coconino and Kaibab NFs in the summer of 2010 detected ponderosa pine mortality associated with bark beetles on approximately 6,500 acres within the project area. This mortality is most likely associated with the Ips beetle (USDA Forest Service "Southwestern Region Insect and Disease Conditions Report 2010"). This survey indicates a tenfold increase in beetle mortality from the 2008 and 2009 surveys, although bark beetle activity in ponderosa pine is currently considered to be at endemic levels. Preliminary results of the 2011 survey indicate a minor reduction in ponderosa pine mortality from 2010. In pinyon-juniper

[13] Projects selected include those that had a hazardous fuels reduction component including Arboretum WUI, Fort Valley, A-1, Rocky Park, Lake Mary, Kachina Village, Woody Ridge, Mormon Lake, Skunk Canyon, Elden, Eastside, East Clear Creek, Elk Park, Munds Park, and Slate Mountain. Where both thinning and prescribed fire had been implemented, the higher, more inclusive acreage number was selected.

woodlands, both localized and widespread mortality events have occurred over time on the Coconino and south Kaibab NFs. These events have typically been pinyon Ips outbreaks associated with periods of drought, such as occurred in the 1950s, and more recently in the mid-1990s and 2001 through 2003.

Juniper mortality from wood borers and Phloeosinus beetles has occurred in areas of poor site quality within the project area during the recent drought (Mueller et al. 2005, USDA Forest Service 2002, 2003). Juniper mortality averaged 3.3 percent within an 80 kilometer radius of Flagstaff, with greater mortality on grassland versus nongrassland sites (Gitlin et al. 2006).

In aspen, mortality has been attributed to the severity of the 1999 frost damage, severe drought conditions, and western tent caterpillar defoliation in 2004 and 2005. Although dying trees sprouted, survival has been very low due to browsing by elk. Mortality has been greatest in the low-elevation range. During the past 5 years, more than 50 percent of surveyed aspen sites below 7,500 feet elevation experienced 97 percent mortality (Fairweather et al. 2008).

In summary, as agents of change, forest insects and diseases have a significant role in forest ecosystem dynamics. Forest insect and disease driven change alters forest ecological processes, forest structure, and composition. At one time or another, all of the vegetation types within the project area have incurred extensive damage by one or more agents (table 149). The transitory agents causing the most extensive and severe damage have been pinyon Ips in pinyon pine, Ips bark beetle species in ponderosa pine, and multiple biotic and abiotic agents in aspen. Each of the vegetation types shows distinct periods of increased insect damage that can be associated with droughts. The most extensive and damaging persistent agent is southwestern dwarf mistletoe in ponderosa pine. More detailed information can be found in Lynch et al. 2008a and 2008b.

Table 149. Acres affected by insect and disease outbreaks by forest (within project area)

Time Period	Insect/Disease Type	Acres and/or Percent of Forest Affected	
		Coconino	Kaibab
1950s	Bark beetle (ponderosa pine) damage	200,000	NA
1950s	Wood borers and Phloeosinus beetle (juniper woodland) mortality	Unquantified – described as extensive	
1970s to 1980s	Western bark beetle (ponderosa pine)	NA	Unquantified
1980s	Southwestern dwarf mistletoe (ponderosa pine) infection	19,773 to 306,489 (2 to 31%)	247,169 to 375,696 (2 to 38%)
1999	Needleminer (ponderosa pine)	9,000	NA
2000s	Bark beetle (ponderosa pine) damage	72,000	NA
2000s	Bark beetle (ponderosa pine) mortality	100% mortality in select stands	29,660 (3%)
2002–2005	Wood borers and Phloeosinus beetle (juniper woodland) mortality	3% mortality within 50 mile radius around Flagstaff*	Extensive
2005–2008	1999 frost and 2004–2005 western tent caterpillar defoliation (aspen) mortality	97% mortality in >50 percent of surveyed aspen sites below 7,500 feet (Fairweather et al. 2008).	
2010	Bark beetle (ponderosa pine) mortality	6,500	

*Accurate acreage number not feasible given the amount of non-FS lands included in the 50 mile radius.

Private Property, State, and Other Agency Activities (Table 150)

On the Kaibab NF, from 2001 to 2004, the Rural Communities Fuels Management Partnership thinned over 200 acres of trees on private property in the Parks, Sherwood Forest Estates, Williams, and Sherwood Forest Estates communities to reduce the risk of wildland fire and improve the forest (Kaibab NF news release, August 2004).

The Camp Navajo Army Depot borders both the Kaibab and Coconino NFs and is within the project area. Camp Navajo implemented thinning on 350 acres in 2011to complete post-tornado recovery. Additionally, treating 349 acres is foreseeable in 2012 (Camp Navajo 2012 data).

Approximately 78,184 acres of fuels reduction treatments were conducted on State and/or private lands from 2000 to 2010 through the Greater Flagstaff Forest Partnership (GFFP) and Arizona State Forestry Division cost-share program (GFFP 2010 Report). Projects are conducted within the 180,000-acre GFFP boundary that is within the project area. Examples of projects include NAU (1,893 acres), Sunset Crater (316 acres), ADGF (54,988 acres), and Flagstaff Fire Department (9,203 acres). Treatments were designed for the wildland-urban interface (WUI). Current projects include vegetation thinning and prescribed fire on approximately 100 acres of private property made up of 20 parcels within the GFFP boundary in 2012.

From 2000 to 2010, the Grand Canyon NP conducted approximately 18,970 acres of prescribed burning along the south rim. Activities conducted in this vicinity are adjacent to the Tusayan district, Kaibab NF.

Foreseeable fuels reduction treatments include treating (mechanical thinning/prescribed fire) 245 acres (5 private land parcels) in 2013, 190 acres (4 to 10 parcels) in 2014, and 100 acres of prescribed burning through 2014 (Flagstaff Fire Department, personal communication, February 24, 2012).

Table 150. Past treatments on private, State, and other federally managed lands

Years	Agency/Organization	Acres Treated
2000–2004	Rural Communities Fuels Management Partnership	200
2000–2010	Greater Flagstaff Forest Partnership (GFFP)	78,184
2000–2010	Grand Canyon NP – South Rim	18,970
2011	Camp Navajo Army Depot	350
Total		**97,704**

Summary of Current and Ongoing Projects

The ongoing and current projects category focuses on those projects that have the potential to affect vegetation (structure, pattern, and composition), natural processes (such as fire), and movement toward increased forest resiliency and function. Specialists evaluated whether additional projects (not included in this list) are relative to their cumulative effects analysis. This category includes vegetation and prescribed fire projects that still have acres remaining for implementation.

The forests have been annually implementing a portion of the total acres specified in the NEPA decisions. It is typical for vegetation and prescribed fire projects to be implemented over a course of 1 to 10 years, depending on size and complexity. Only those acres that remain to be implemented are reflected in this category. Projects that included periodic (maintenance) prescribed fires are included in this category. The assumption for other projects such as power line maintenance conducted by special use permit holders is that the vegetation within the entire right-of-way could be maintained annually. In summary, approximately 82,592 acres of vegetation treatments and 97,175 acres of prescribed fire are in the current and ongoing category within the project area (table 151 and figure 77). Table 152 includes other projects considered.

Table 151. Current and ongoing vegetation (mechanical) and prescribed fire projects

Project Name	Treatment Type	Mechanical/ Prescribed Fire (acres)	Forest/District	
			Coconino	Kaibab
Pomeroy	Mechanical and prescribed fire	1,740/1,740		Williams
KA		1,050/1,050		Williams
Russell		5,000/5,000		Tusayan
Community Tank		865/865		Williams
Bill Williams Cap		10/10		Williams
Ten X	Prescribed fire	700		Tusayan
Airport		602		Tusayan
South Williams		290		Williams
Long Jim		1,300		Tusayan
Dogtown	Mechanical and prescribed fire	1,700/1,700		Williams
Twin	Prescribed fire	1,400		Williams
Frenchy		6,529		Williams
Tusayan South/Boggy Tank		2,948		Tusayan
Tusayan East		2,600		Tusayan
Arboretum		602	Flagstaff	
Woody Ridge		11,184	Flagstaff	
Post-Tornado	Mechanical (tree removal)	18,756	Flagstaff and Mogollon Rim	
Hart Prairie	Mechanical and prescribed fire	9,815/9,815	Flagstaff	
Munds Park	Prescribed fire	2,950	Flagstaff	
A-1 East and West		8,274	Flagstaff	
East Clear Creek	Mechanical and prescribed fire	1,562/4,700	Flagstaff	
Mormon Lake	Prescribed fire	2,388	Flagstaff	
Skunk Canyon		831	Flagstaff	

Project Name	Treatment Type	Mechanical/ Prescribed Fire (acres)	Forest/District	
			Coconino	Kaibab
Eastside		20,197	Flagstaff	
Power lines, oil and gas lines, natural gas/FERC, meter sites, gas compression and substation sites*	Right- of-way vegetation clearing for maintenance purposes and to reduce fire risk	30,710	Forestwide	
Power lines, oil and gas lines, natural gas/FERC, meter sites, gas compression and substation sites*	Right- of-way vegetation clearing for maintenance purposes and to reduce fire risk	1,634		Forestwide
Bobs (part of Woody Vegetation project)	Mechanical and prescribed fire	2,000/2,000	Flagstaff	
Clark's (part of Elk Park project)		1,600/1,600	Flagstaff	
Elk Park Fuels		2,900/2,900	Flagstaff	
Jack Smith-Schultz		2,000/2,000	Flagstaff	
Weatherford (part of Jack Smith Schultz and Eastside)		1,000//1,000	Flagstaff	
Railroad		250 /250	Flagstaff	
Summary of Acres				
Total acres of vegetation treatments (including powerline maintenance)		**82,592 acres**		
Total acres of prescribed fire		**97,175 acres**		

Table 152. Current and ongoing other projects

Project Name	Project Purpose	Description	Forest/District	
			Coconino	Kaibab
Treatment of Noxious Weeds-3 Forests	Direction incorporated into forest plans	Encompasses project area	Forestwide	Forestwide
Firewood collection	Forestwide policy			Williams and Tusayan
Tusayan Travel Management				Tusayan
Williams Travel Management				Williams
Coconino NF Travel Management				
Coconino and Kaibab NFs road maintenance	Annual road maintenance		500 miles per year on each forest	
Grazing	Continuation of authorized livestock grazing	791,250 acres/80% of project area	47 active allotments within project area, see the range report for a complete list of allotments within project area	
Wildlife waters	Water development maintenance	24 water developments		Tusayan
Little Draw	Aspen exclosure maintenance	107 acres	Flagstaff	

*The numbers in this category are for the entire permitted facility and likely include acres outside the project area. Data that would have been specific to the project area was not readily available.

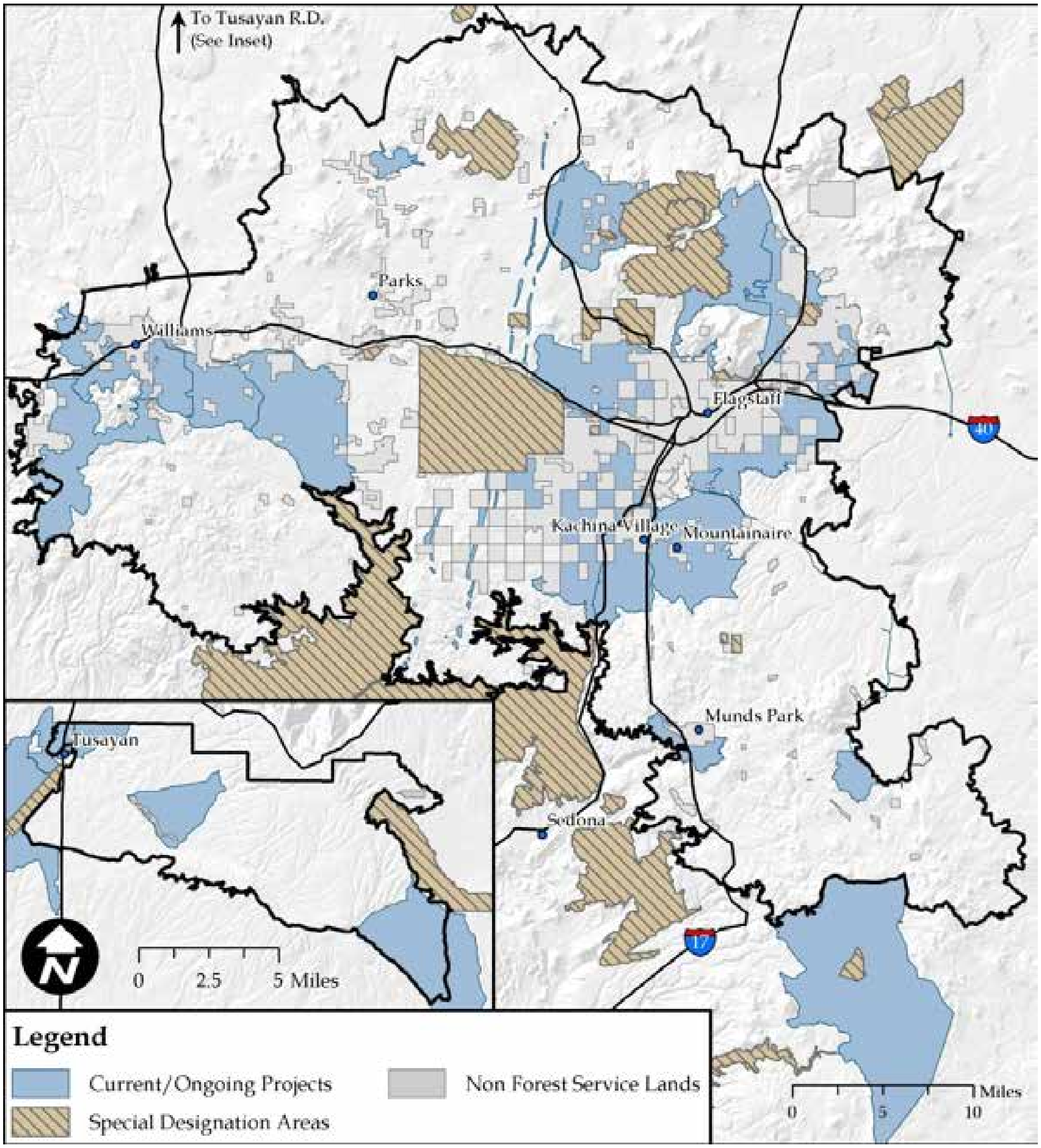

Figure 77. General locations of current and ongoing projects within or adjacent to the project area

Summary of Reasonably Foreseeable Projects

Reasonably foreseeable projects for this analysis (table 152 and table 153, and figure 78) are defined as those Forest Service projects that have been listed in the forests' schedule of proposed actions (SOPA). The most recent SOPA for both forests was reviewed in January 2013 (USDA 2013). Decisions are imminent or decisions have been made and implementation is about to begin; or the projects are poised for implementation by other (non-FS) parties. The reasonably foreseeable category mostly focuses on those projects that have the potential to affect vegetation (structure, pattern, and composition), natural processes (such as fire), and movement toward increased resiliency and function. Some project, such as the rock pits analysis, would not affect vegetation structure, spatial pattern, or composition. However, this project has been included as it may affect how road proposals (and their associated costs) are analyzed and implemented. Specialists also evaluated whether additional projects (not included in this list) would be included in their cumulative effects analysis. In summary:

- Approximately 86,771 acres of vegetation (mechanical) treatments and 142,869 acres of prescribed fire and maintenance burning would be implemented by the forests in the foreseeable future (within 5 years) (table 153). Table 154 displays foreseeable recreation projects.
- Approximately 18,552 acres of vegetation (mechanical) treatments and 19,082 acres of prescribed fire and maintenance burning is expected to be implemented on State, private, and other federally managed lands within the foreseeable future (within 5 years) (table 155).
- Projects that are foreseeable but located outside of the project area are displayed in table 156.

Table 153. Reasonably foreseeable vegetation management/ground-disturbing projects within and adjacent to the project area

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Aspen Restoration Project	Mechanical and prescribed fire	402 acres mechanical and prescribed fire		Williams	Promote aspen by removing conifer encroachment, using prescribed fire, and protecting with fencing Status: analysis underway, decision likely in 2013
McCracken Project	Mechanical and prescribed fire	15,262 acres mechanical 17,337 acres. prescribed fire		Williams	Move toward uneven-aged forest structure, reduce mistletoe, restore meadows, savanna, and woodlands Status: decision likely in 2013
Ten X Fire Planting	Post-fire planting and fencing	12 acres (mechanical)		Tusayan	Restore vegetation within 815-acre high-severity burn Status: analysis underway
Bill Williams Mountain Restoration	Mechanical, prescribed fire, roads	11,650 acres mechanical 15,200 acres prescribed fire 28 miles road decommission and 23 miles temporary road construction		Williams	Reintroduce fire, reduce stand densities and fire potential, move toward balanced age classes, improve understory composition and productivity Status: analysis underway, decision likely in 2012

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Coconino and Kaibab NFs Rock Pit Development	Existing pit expansion and new pit development	39 pits, 229 acres (new disturbance)	Forestwide	Forestwide	Create source of materials for road maintenance and management Status: analysis underway, decision likely in 2012
Marshall Fuels Reduction	Mechanical and prescribed fire	10,800 acres mechanical and 6,260 acres prescribed fire	Flagstaff		Ponderosa pine, grassland, meadow, and water fowl habitat restoration (includes 900 acres of thinning up to 9-inch d.b.h. in MSO habitat), reduce fire risk Status: decision made, 2012 implementation
Turkey/ Barney Pasture Forest Health Restoration	Mechanical and prescribed fire	Potentially 17,835 acres of mechanical and prescribed fire	Flagstaff		Reduce dwarf mistletoe, tornado salvage, improve MSO habitat Status: analysis underway, decision likely in 2012
Upper Beaver Watershed Fuels Reduction (90% outside the project area)	Mechanical and prescribed fire	15,807 acres mechanical 31,162 acres prescribed fire 43,906 acres maintenance burning			Reduce fire risk within and outside of WUI Status: 2,000 acres scheduled for 2013 implementation
Western Area Power Administration Flagstaff to Pinnacle Peak	Mechanical	4,584 acres	Flagstaff		Remove trees that may impinge on power lines: 1,770 acres ponderosa pine, 8 acres aspen, 10 acres cottonwood/willow riparian, 25 acres wetland cienega, 35 acres montane/subalpine grass, 175 acres semi-desert grass, 810 acres pinyon-juniper evergreen shrub, 1,280 acres pinyon-juniper woodland Status: Analysis underway, decision likely in 2012
Wing Mountain	Mechanical and prescribed fire, road decom-mission	10,190 acres mechanical and 10,767 acres prescribed fire	Flagstaff		Restoration in ponderosa pine, mountain grassland, pine savanna, aspen and spring (Maxwell and Big Leroux) restoration, 8 miles of road decommission

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Acre Summary					
Vegetation treatments and foreseeable ground disturbance			**86,771 acres (86,542 (mechanical) + 229 acres (ground disturbance from pits)**		
Prescribed fire (including maintenance burning)			**142,869 acres**		

Table 154. Reasonably foreseeable recreation projects within the project area

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Kelly Motorized Trails	Motorized trails	73 miles of single track (motorcycles) and motorized trail (ATV, UTV)	Flagstaff district		*6 miles of road to single-track trail conversion *25 miles of new construction for single track *6 miles of user created trail converted to single-track system trail *17 miles of road converted to motorized trail *11 miles of level 2 road converted to motorized trail 8 miles of new motorized trail construction
Mt. Elden/Dry Lake Hills Recreation	No proposal exists at this time				The purpose of the project is to provide enhanced recreation opportunities, mitigate impacts to wildlife habitat, archaeological sites, soil, water, and address community interests. No spatial data
Highway 180 motorized trails	Motorized trail construction and conversion of user-created trails to motorized NF system trail in the White Horse Hills and Hochdeffer Hills area	Potentially up to 60 miles of motorized trail			No proposed action has been developed at this time No spatial data

Table 155. Other agency and private lands foreseeable vegetation and prescribed fire projects

Other Agency and Private Lands					
Camp Navajo Westside Thinning and Prescribed Fire Project	Mechanical and prescribed fire	968 acres mechanical and prescribed fire 530 acres prescribed fire only	Flagstaff	Williams	Improve forest health, reduce fire risk Status: 2013 implementation
Department of Defense AZARNG Thin and Burn	Mechanical and prescribed fire	17,049 acres mechanical and prescribed fire			Ponderosa pine, pine-oak, and grasslands restoration to mitigate fire risk, provide diversity in forest conditions, improve ecosystem health, reduce tree density in 5-inch to 18-inch d.b.h.
Greater Flagstaff Forest Partnership (GFFP)	Mechanical and prescribed fire	535 acres mechanical and prescribed fire	Flagstaff		Reduce fire risk on private property Status: implement in 2013 and 2014
Acre Summary					
Vegetation mechanical treatments			**18,552 acres**		
Prescribed fire and maintenance burning			**19,082 acres**		

Table 156. Other foreseeable vegetation and prescribed fire projects outside the project area

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Clints Well Forest Restoration	Mechanical and prescribed fire	12,912 acres mechanical (includes 10,522 acres of WUI) 3,987 acres no treatment 16,467 acres prescribed fire (includes 10,522 acres of WUI)	Mogollon Rim		Fuel reduction and ecosystem restoration over approximately 16,809 acres within and adjacent to the WUI of Clints Well including: 779 acres MSO PAC thinning <9-inch d.b.h. 3,778 acres MSO restricted habitat maintenance 1,043 acres MSO threshold habitat maintenance 412 acres goshawk PFA maintenance 184 acres goshawk PFA core

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
					nest area 225 acres insect and disease 529 acres timber stand improvement 3,448 acres uneven-aged development and 2,200 acres uneven-aged maintenance 294 acres firewood cutting
Mahan-Landmark Forest Restoration	Specifics are unknown as no proposed action has been developed	33,747-acre project area	Mogollon Rim		Objectives: (1) vegetation structure and diversity with a mosaic of interspaces and tree groups of varying sizes and shapes; (2) forest structure with all age and size classes in goshawk and MSO habitat; (3) old age trees are sustained over time across the landscape; (4) improved forest health with reduced stand density-related mortality and reduced level of dwarf mistletoe infection; (5) improved vegetation diversity and composition in Gambel oak, aspen, pinyon-juniper, and grasslands; (6) resilient forest -reduced potential for undesirable fire behavior and its effects; (7) maintain a mosaic of tree groups and interspaces with frequent, low-severity fire; (8) springs and seeps function at, or near, potential; (9) restore degraded ephemeral channels; (10) restore select closed and unauthorized roads
69 kV Winslow Blueridge	Construct 11 miles of corridor on NF lands and construct a new substation in Blue Ridge	55 acres of vegetation clearing 50 acres of small timber products sale	Mogollon Rim		Construct a 69 kilovolt (kV) transmission line to connect the Winslow substation in Winslow with a new substation in the Blue Ridge area

Project Name	Treatment Type	Metric	Forest/District		Project Objective Summary and Status
			Coconino	Kaibab	
Grapevine Interconnect	9 miles of new 345 kV electric transmission line	9 miles vegetation removal			Approximately 9 miles of new 345 kV electric transmission line connecting a new wind park located on Flying M Ranch private property and State lands to the existing Western Area Power Authority (Western) 345 kV line
Bill Dick Springs Enhancement	No proposal at this time	Unknown No spatial data	Mogollon Rim		Enhance and restore water availability at a currently developed but marginally functioning spring to provide water for livestock, bats, amphibians, elk, and other wildlife
Blue Ridge Community Fire Risk Reduction	No proposal exists at this time, location is: Mogollon Ranch and Ponderosa Pines subdivision	50 acres – assume mechanical and prescribed fire Spatial data created	Mogollon Rim		Implement fuels reduction treatments in the Blue Ridge/Happy Jack area of Coconino County, AZ, about 50 acres of subdivision lots (1–5 acres in size) for the purpose of creating defensible space and improving and protecting forest health.
Cinch Hook Rock Pit Use	Rock removal from within the existing development limits		Mogollon Rim		Located near the junction of State Highways 87 and 260 Objective: material for road maintenance, administrative site improvements, and timber sale projects Incorporated into forestwide rock pit analysis
Allen Lake Restoration	Unknown		Mogollon Rim		Proposed action not developed at this time
Pronghorn Habitat Improvements	Proposal has not been developed at this time		Red Rock		Improve habitat for pronghorn Scoping began on 1/20/2012
Greater Flagstaff Forest Partnership (GFFP)	Mechanical and prescribed fire	535 acres mechanical and prescribed fire	Flagstaff		Reduce fire risk on private property Status: implement in 2013 and 2014

Reasonably Foreseeable Projects With Insufficient Information for Analysis

The Long Valley Restoration Project (953 acres of mechanical and 706 acres of prescribed fire) on the Mogollon Rim is in “hold” status and no decision is expected in the foreseeable future. For this reason, it was eliminated from the cumulative effects reasonably foreseeable category.

The Four-Forest Restoration Initiative, Apache-Sitgreaves NFs and Tonto NF, has no tangible information that would be meaningful for this cumulative effects analysis. No project boundary has been created, no decision has been made on the existing and desired condition of resources (no purpose and need for action); therefore, no specific activities have been proposed. For this reason, it was eliminated from the cumulative effects reasonably foreseeable category.

Flagstaff Watershed Protection Project: There are about 3,670 acres in the vicinity of Dry Lake Hills and Mormon Mountain that are likely to receive restoration actions in the foreseeable future (2013). The project is a partnership between the city of Flagstaff and Coconino NF. No purpose and need for action has been developed for the project; therefore, no specific activities have been proposed. At this time, this project has been eliminated from the cumulative effects reasonably foreseeable category.

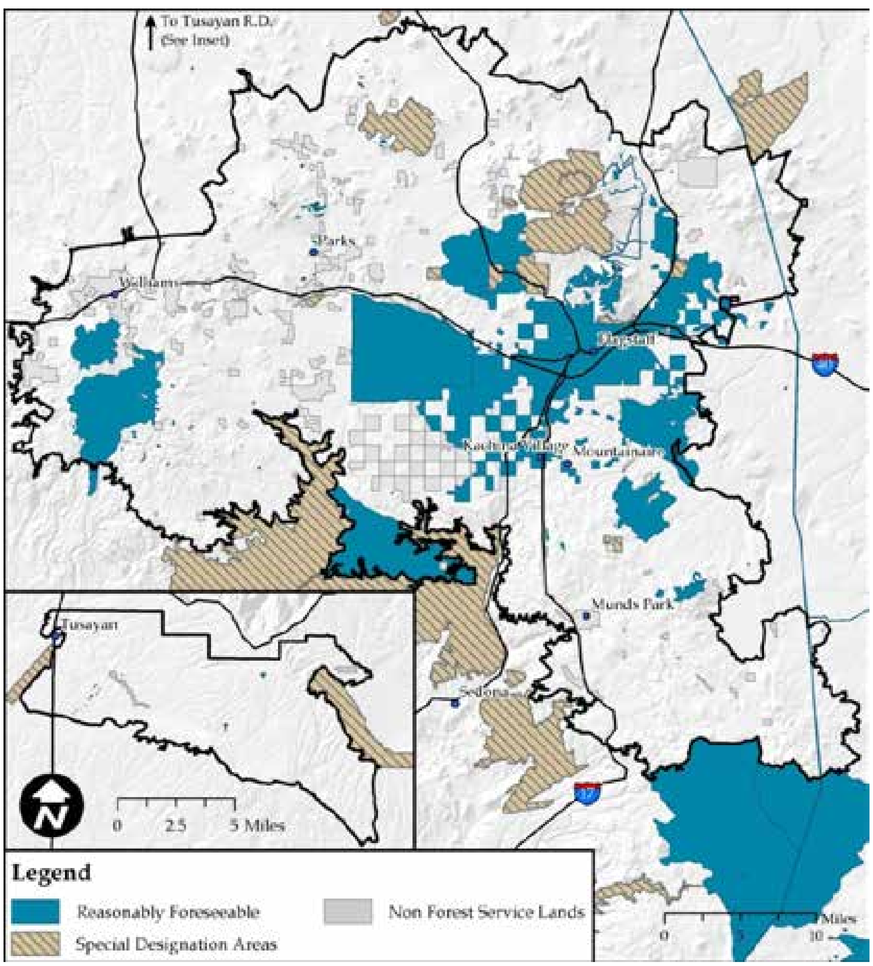

Figure 78. General locations of foreseeable projects within or adjacent to the project area

Appendix G – Bridge Habitat

The 4FRI project would not achieve desired conditions on all treatment acres immediately post-treatment; as it would take time for the largely even-aged forests to develop uneven-aged structure, for trees to mature into larger diameter classes, and for tree canopies within tree groups to reach the desired interlocking crown condition. Because of this, there is a concern that post-treatment conditions within the 4FRI project area would not provide sufficient habitat for canopy-dependent wildlife in the short term.

The wildlife species of concern identified by our publics include the northern goshawk, the MSO, Abert's squirrel, turkey, mule deer, black bear, and some songbird species. The information provided in this appendix clarifies how post-treatment conditions within the 4FRI project area would provide habitat for canopy-dependent wildlife in the short term. We are referring to those areas as "bridge habitat," suggesting that these more densely forested areas would be available to wildlife to bridge the time between treatment and the attainment of desired conditions across the broader landscape.

Bridge Habitat at the Landscape Scale

For purposes of this discussion, the landscape is considered to be the 988,764-acre 4FRI Coconino and Kaibab NFs' project area. To clarify where and how much bridge habitat would be available to canopy-dependent wildlife at the landscape scale, some review of the acreage categories may be helpful. Table 157 displays an accounting of project area acres in terms of what was considered for management actions and what was excluded from consideration under this EIS. All treatment area acreages are calculated based on alternative C because it is the preferred alternative and has the most comprehensive set of potential treatments that could impact canopy-dependent wildlife.

Table 157. Acres of treatment and nontreatment areas within the 4FRI project area

	Description	Acres
Project Area	Total area within 4FRI project boundary	988,764
Exclusions	Total excluded area within 4FRI project boundary	395,553
	Other projects	204,957
	Special management areas (wilderness, research natural areas, inventoried roadless areas, Camp Navajo, and experimental forests)	29,821
	Non-FS lands	145,156
	Miscellaneous (other cover types, no treatment protected activity center (PAC) core areas, inaccessible areas, etc.)	15,618
Treatment Area	Area within the proposed treatment boundary (includes mechanical treatment and prescribed burning)	593,211
	Ponderosa pine treatment area	512,178
	Other cover types treatment area	81,033

At the landscape scale, there is a highly diverse mosaic of patches that would vary in terms of overall density and openness post-treatment. Two bridge habitat categories ("other projects" and "wilderness, slopes, PACs") were analyzed at the scale of the total project area to demonstrate the patch-mosaic of deferrals versus treated areas across the larger landscape. The remainder of the bridge habitat categories that were analyzed are at the ponderosa pine treatment area (512,178 acres) scale. This scale was used to demonstrate how bridge habitat would persist where mechanical treatments and prescribed fire are proposed. The percentages provided for each category are not necessarily additive. Some categories are merely subsets of other categories but they provide several different ways of looking at how we account for closed-canopy species through project design.

Project Area Scale

Other projects: Excluded fuels reduction and forest restoration projects account for 204,957 acres (21 percent) of the total project area (988,764 acres). We can assume that some proportion of these projects would/do retain closed-canopy conditions after treatment or remain untreated. The average proportion of projects that would be untreated on the Coconino and Kaibab NFs is roughly 37 percent, due to site-scale factors such as archaeological and historical sites, wildlife deferrals, funding issues, and areas with insufficient road access (Hampton et al. 2008, page 17). Using this estimate of 37 percent remaining untreated, we extrapolated that 8 percent (75,834 acres) of the total project area would likely remain in deferral simply due to site-scale logistics and protection measures on these excluded projects. Though data were not available to arrive at an accurate percentage of those excluded projects that remain in deferral or closed-canopy condition, we assume that some proportion of this area would contribute to available habitat for canopy-dependent species.

Wilderness Areas, Slopes >40 percent, and MSO PACs not identified for mechanical treatment: These areas have not been identified for mechanical treatment (including 81 of 99 MSO PACs) and are generally characterized by dense forest conditions used by canopy-dependent wildlife. These areas account for 8 percent (79,382 acres) of the total project area.

Ponderosa Pine Treatment Area Scale

Treated areas remaining in closed (10 to 25 percent open) to moderately closed (25 to 40 percent open) condition post-treatment: This category includes mechanically treated and prescribed fire only areas where post-treatment conditions maintain 60 to 90 percent forested cover. Included in the analysis were areas outside and within northern goshawk PFAs where post-treatment openness would be 10 to 25 percent and 25 to 40 percent, northern goshawk nest areas, MSO restricted and target/threshold habitats, and 18 MSO PACs proposed for mechanical treatment. Total acreage for this category is 213,084 or 42 percent of the ponderosa pine treatment area. If we only look at areas that would remain in closed condition (75 to 90 percent forested) post-treatment, the total acreage is 84,632 or 17 percent of the ponderosa pine treatment area. This percentage includes all those areas listed above, but excludes areas in the 25 to 40 percent open category. Table 158 provides acreages by post-treatment openness within the ponderosa pine treatment area. Also, see figure 79.

Table 159 provides a detailed summary of acreages and percentages for each treatment category within the ponderosa pine treatment area in terms of post-treatment density and contributions to bridge habitat. Table 159 demonstrates the patch-mosaic of denser forests (post-treatment) relative to areas that would be more open after treatment. The narrative following table 159 and figure 79 discusses habitat specific post-treatment density.

Table 158. Acres of proposed treatment in terms of post-treatment openness

Post-treatment Openness Category	Acres	Percent of Ponderosa Pine Treatment Area
Very Open	56,692	11
Open	154,524	30
Mixed (LOPFA prescribed fire only)	87,879	17
Moderately Closed	128,452	25
Closed	84,632	17
Total	**512,178**	**100**

Table 159. Post-treatment contributions to bridge habitat provided by each treatment designation

Treatment	Post-treatment Density	Landscape Scale Bridge Habitat	Mid-scale Bridge Habitat	Total Acres	Percent of Ponderosa Pine Treatment Area
Mechanical Treatment					
Low Density	Savanna/Grassland Restoration	X	X	56,692	11
	LOPFA 40–55% Interspace	X	Some	141,628	28
	PFA 40–55% Interspace	X	Some	12,895	3
Low Density Total				211,252	41
Moderate Density	LOPFA 25–40% Interspace	X	X	53,058	10
	MSO Restricted	X	X	63,191	12
	PFA 25–40% Interspace	X	X	4,800	1
Moderate Density Total				121,050	24
High Density	LOPFA 10–25% Interspace	X	X	29,776	6
	PFA 10–25% Interspace	X	X	2,850	1
High Density Total				32,626	6
Very High	MSO Target/Threshold	X	X	8,410	2

Treatment	Post-treatment Density	Landscape Scale Bridge Habitat	Mid-scale Bridge Habitat	Total Acres	Percent of Ponderosa Pine Treatment Area
Density	MSO PAC Mechanical	X	X	10,741	2
Very High Density Total				19,151	4
Prescribed Fire Only Areas					
Low/Moderate Density	LOPFA Prescribed Fire Only	Some	Some	87,879	17
Low/Moderate Density Total				87,879	17
Moderate/High Density	PFA Prescribed Fire Only	X	X	3,216	1
	Restricted Prescribed Fire Only	X	X	4,187	1
Moderate/High Density Total				7,403	1
Very High Density	PFA Nest Area Prescribed Fire Only	X	X	6,839	1
	Target/Threshold Prescribed Fire Only	X	X	303	0
	Protected Prescribed Fire Only	X	X	25,714	5
Very High Density Total				32,626	6
Grand Total				**512,178**	**100**

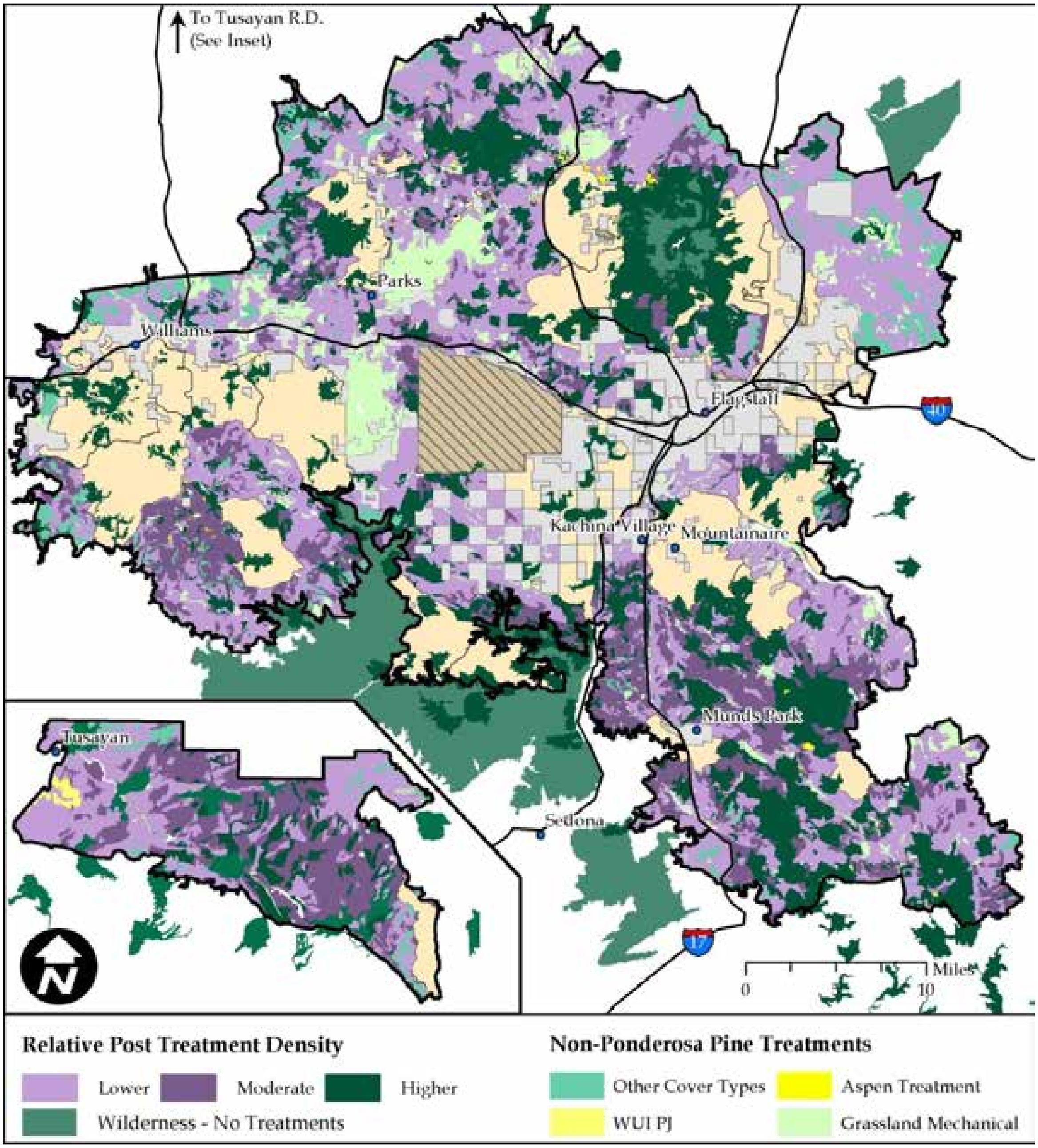

Figure 79. Relative, post-treatment forest density across the 4FRI project area, alternative C

MSO protected, target/threshold, and restricted habitats: These three habitat designations have specific guidelines per the MSO recovery plan to meet the denser forest conditions selected for by the owl. Within the 4FRI project, these designations could be ranked in terms of their forest density and, therefore, their provision of bridge habitat for other closed-canopy species. Protected habitat is generally densely forested, target/threshold habitat is similar to protected habitat, and restricted habitat is slightly less dense than protected but still more densely forested relative to the surrounding treated areas outside MSO designations.

- Protected owl habitat accounts for roughly 36,455 acres, which is 7 percent of the ponderosa pine treatment area (table 159, see the "MSO PAC Mechanical" and "Protected Prescribed Fire Only" row in the "Post-treatment Density" column). This designation includes 72 PACs (18 of which are proposed for some mechanical thinning) and slopes >40 percent. Protected owl habitat is designed to provide a multilayered, more closed canopy condition relative to the other habitats in the ponderosa pine treatment area, with an emphasis on managing for large trees (18-inch d.b.h. or greater). The average basal area for protected habitat, based on modeled projections for the year 2020, is 154 square feet per acre.
- Target/threshold habitats include those areas that meet or are approaching protected habitat conditions, specifically within the pine-oak vegetation type. These areas account for 2 percent (8,410 acres,) of the ponderosa pine treatment area (see MSO target/threshold row in table 159). Per the MSO recovery plan, the guideline within target/threshold habitats is to manage for ≥15 percent of total SDI in each of the three targeted ponderosa pine tree size classes (12- to18-inch d.b.h., 18- to 24-inch, and >24-inch), and a stand average of 110 to 150 square feet per acre basal area at the stand level with a preponderance of large trees (≥18-inch d.b.h.).
- Restricted habitat accounts for 67,191 acres (table 159), which is 12 percent of the ponderosa pine treatment area. Like target/threshold, this is also specific to pine-oak in the 4FRI project. The guidelines for restricted habitat are less specific and operate in conjunction with ecosystem management and existing management guidelines. 4FRI objectives include managing for an abundance of ponderosa pine trees larger than 18-inch d.b.h., maintain tree form oak, and manage for a stand average of 70 to 90 square feet per acre basal area at the stand level.

Northern goshawk habitat: Closed canopy conditions would also be realized within areas managed according to the northern goshawk guidelines. Higher tree density, canopy cover, and larger group sizes would be retained in the PFAs and LOPFAs where the post-treatment density remains high (10 to 25 percent interspace, 32,626 acres) (table 159). Denser forest structure would also be retained in northern goshawk nest areas, all of which have been identified as burn only (6,839 acres) (see the "PFA Nest Areas Prescribed Fire Only" row in table 159). Together, these categories account for 8 percent of the ponderosa pine treatment area. In addition, PFA and LOPFA proposed for moderately dense condition (25 to 40 percent interspace) account for 11 percent of the ponderosa pine treatment area (see the "Moderate Density" category in "Mechanical Treatment Areas" in table 159. About 41 percent of the ponderosa pine treatment area is LOPFA and PFA goshawk habitat proposed for low density condition (savanna/grassland restoration and 40 to 55 percent interspace) (table 159).

Wildlife movement corridors: Efforts were taken to ensure habitat connectivity for canopy-dependent wildlife at the landscape scale using data from known wildlife movement corridors for black bear, turkey, mule deer, and tassel-eared squirrels (AGFD 2011, figure 51). In areas where canopy-dependent wildlife corridors overlapped with proposed mechanical treatments, treatment intensities were strategically designed to leave areas with closed or moderately closed conditions post-treatment. In addition to areas that were already proposed to remain in at least moderately closed condition, roughly 4,276 acres were actively changed from a more open treatment. Adjusted treatment areas were located within five different wildlife movement corridors within the project area. This action was taken to ensure adequate retention of thermal and hiding cover for the wildlife that depends on closed-canopy conditions for their movement across the landscape. (The inverse was done for open-canopy dependent wildlife corridors, where treatment intensities were designed to create open or very open conditions post-treatment. Open-canopy corridors were identified for pronghorn, Gunnison's prairie dog, and American badger).

In summary, there are four key considerations with regard to bridge habitat for closed-canopy species at the landscape scale:

1. At the project area scale, a patch-mosaic of bridge habitat would remain available for canopy-dependent wildlife. At a minimum, 8 percent of the project area would be in deferral due to wilderness, slope, and MSO untreated PACs. Potentially another 8 percent of the project area would be in deferral as part of other excluded projects.
2. Roughly 1 in 5 acres (22 percent of the ponderosa pine treatment area) would be managed as MSO habitat, creating conditions that also provide bridge habitat for other canopy-dependent wildlife.
3. Bridge habitat would be maintained across 42 percent of the ponderosa pine treatment area, despite the use of mechanical and burning treatments.
4. Project area connectivity for closed-canopy species was specifically built into treatment designs separately from MSO and northern goshawk guidelines.

Bridge Habitat at the RU Scale

At the RU scale (figure 80), there are additional ways of accounting for bridge habitat. Factors contributing to bridge habitat at the RU scale include the area remaining in closed and moderately closed condition post-treatment and areas allocated for old growth.

Treated areas remaining in a closed (<25 percent interspace) to moderately closed (25 to 40 percent interspace) condition post-treatment: Table 160 summarizes the range of post-treatment openness by RU under alternative C. (Also, see table 64 in the silviculture specialist's report). Overall ranges indicate a fairly diverse condition within RUs, with openness leaning toward the moderately closed to closed side of the range. RU 1 has the highest percentage of post-treatment habitat in a closed condition, due in large part to ecological conditions such as soil, climate, and site quality that result in a denser reference condition relative to the other restoration units. RU 1 also contains the highest proportion of MSO habitat relative to the other RUs. Note that RU 3, 4, and 6 include savanna, grassland, and pine-sage habitats (e.g., Garland Prairie in RU 3, Government Prairie in RU 4, and pine-sage in RU 6). Savanna and grassland restoration is based on soil characteristics and would total 56,692 acres of very open treatment. RU 5 shows a different distribution of habitat and this is largely based on the amount of prescribed fire only acres. Although some of these acres may be more open, few mechanical treatments have occurred in the recent past and none are proposed in this project.

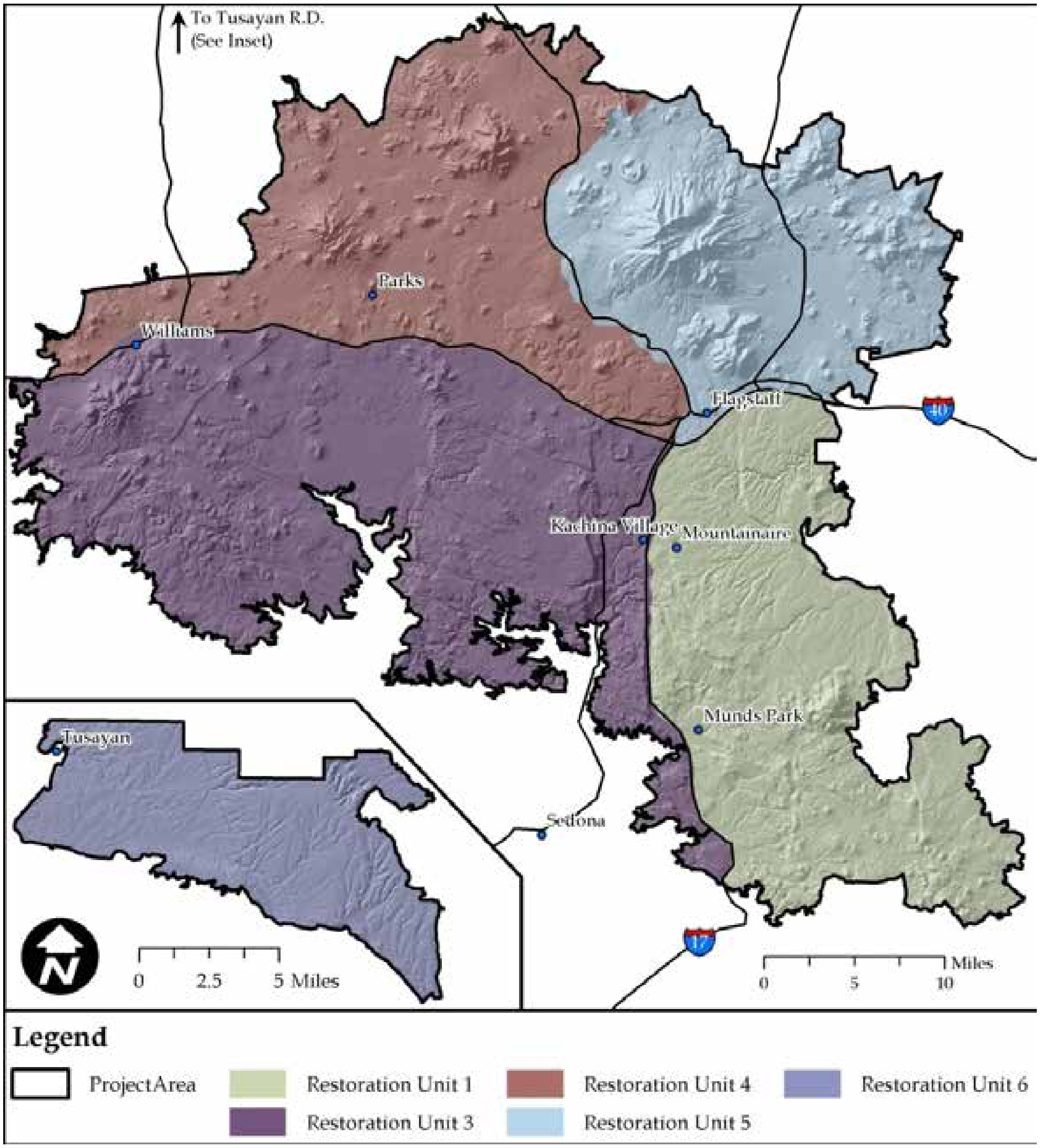

Figure 80. RU boundaries within the 4FRI project area

Table 160. Proposed post-treatment openness condition (Percent) by RU

RU	Very Open	Open	Moderately Closed	Closed
1	10%	32%	20%	21%
3	12%	34%	41%	12%
4	18%	39%	30%	13%
5	2%	5%	87%	6%
6	0%	21%	65%	14%

Areas allocated for old growth: Desired conditions for old growth in ponderosa pine are provided by forest plan direction.

- 20 trees per acre at 18-inch d.b.h. and at least 180 years old,
- one snag per acre at least 14-inch d.b.h. and 25 feet tall,
- two down dead tree pieces 12 inches in diameter and 15 feet long,
- basal area at least 90 square feet, and
- canopy cover of at least 50 percent.

Old growth habitats play a crucial role for many wildlife species in ponderosa pine forests. The microhabitat diversity provided by the old trees, multistoried canopies, and decadent trees/downed logs within old growth areas are rare across the landscape. The forest plans' direction is to allocate and maintain at least 20 percent old growth forest within each ecosystem management unit (EMU). For the purposes of the 4FRI project, the EMU most closely resembles the RU and old growth areas were allocated by RU (see table 38 in the silviculture specialist report).

Since MSOs, and to some extent northern goshawks, are associated with old growth forests, old growth is a subset of those habitats in the 4FRI project (see chapter 1, existing and desired conditions for more details). Forty percent of the ponderosa pine treatment area on the Coconino NF (128,994 acres) and 38 percent (65,810 acres) of the Kaibab NF are allocated for old growth. Current conditions in these areas most closely resemble old growth, but do not currently meet all the forest plan parameters of old growth. It is the intent of the 4FRI project to manage these areas according to old growth standards, moving them toward mature, diverse forest over time. Similar provisions were made for pinyon-juniper habitats.

Bridge Habitat at the Mid-Scale

Bridge habitat for canopy-dependent wildlife would also occur at the mid-scale in the 4FRI project. It is expected that some densely forested areas would be deferred simply due to the vagaries of implementation. The 4FRI project also intentionally plans for bridge habitat at the mid-scale through its desired conditions, design features/best management practices/mitigation, the old and large tree implementation plans, and the silvicultural design and implementation guide. Those elements are described below.

Desired conditions for bridge habitat: During the implementation phase of the 4FRI project, treatment area specific prescriptions for mechanical thinning would be designed based on the desired conditions proposed in this analysis. The following subset of desired conditions helps ensure bridge habitat is maintained in the proposed project area (see chapter 1 purpose and need for the full set of desired conditions):

- The desired condition is to restore tree density and pattern to the natural range of variability, while meeting forest plan requirements for MSO protected and target/threshold habitat and goshawk nest areas.
- At the fine scale, the desired condition is a ponderosa pine ecosystem consisting of groups of trees that typically range in size from 0.1 acre to 1 acre in size. Tree group size

exceeds 1 acre in size as needed to respond to site-specific conditions such as the presence of pre-settlement trees or mature, young trees that are developing old tree characteristics.

- Tree groups in the mid-age and older VSS classes have canopies that provide moderate to closed conditions and connectivity for wildlife that are dependent on this type of habitat. These conditions are widely distributed on the landscape. At the landscape scale (extent of ponderosa pine vegetation), all canopy density conditions exist and provide for heterogeneity.
- Moderate to closed-canopy conditions (and the connectivity between groups supporting these conditions) are met in a variety of ways: habitat for goshawk and MSO, steep slopes, buffers for several resources including bald eagle roosts, other raptor nests, caves, and special designations that would not be treated (including wilderness and most research natural areas).
- There is a need to use management strategies that: (1) promote tree regeneration and understory vegetation, (2) move tree canopy density, tree group pattern and interspaces toward the historic range of variability, and (3) provide a mix of open, moderately closed, and closed-canopy conditions at the fine (group) to landscape (ponderosa pine vegetation) scale.
- There is a need to implement uneven-aged management strategies and manage for high density, relatively uneven-aged stands in MSO restricted habitat, including target/threshold habitats to meet forest plan and MSO recovery plan requirements.

Wildlife design features/best management practices/mitigation measures: These components of the project design provide safeguards for wildlife and other resources during the implementation phase. Those listed in table 161 are those that best illustrate how treatment area design features would result in a well-distributed network of bridge habitat for wildlife across the larger landscape. For a more complete list of design features, BMPs, and mitigation, see appendix C, as well as the silvicultural design and implementation guide found in appendix D. See also table 36 of the wildlife specialists report. Silvicultural design features that contribute to bridge habitat are described in greater detail below.

Old and large tree implementation plans: In response to public input from several stakeholders requesting a design feature of the proposed action include no cutting of pre-settlement old growth trees, the 4FRI project implements an old tree implementation plan. Old trees (approximately ≥150 years old) would be retained regardless of their diameter within the 4FRI project area. Exceptions would be made for threats to human health and safety and those rare circumstances where the removal of an old tree is necessary in order to prevent additional habitat degradation. Retention of old trees as individuals and groups will contribute significantly to bridge habitat, providing old growth structure for wildlife in the short term.

In response to input from some stakeholders, alternative C includes a large tree implementation plan. The strategy identifies areas where large, post-settlement trees (≥16 inches d.b.h.) would be retained and those exceptions where removal of large, young trees would be necessary to move toward ecological desired conditions. Exception categories include the WUI and the following ecological sites where young tree encroachment is inhibiting ecological function: seeps and springs, riparian areas, wet meadows, grasslands, aspen forest and woodland, pine-oak forest, within-stand openings, and heavily stocked stands (with a high basal area) generated by a preponderance of large, young trees. Elsewhere, those trees would be retained, adding to the mid-scale provision of bridge habitat for canopy-dependent wildlife.

Silvicultural design and implementation guide: Vertical and horizontal heterogeneity are important components of wildlife habitat in ponderosa pine forests. Restoring variability and diversity to forest structure and pattern is a central desired condition of the 4FRI project. The silvicultural design and implementation guide (hereafter "implementation guide"; appendix D) is intended to translate desired conditions, management direction, and design features into guidance for the district silviculturists responsible for writing site-specific prescriptions in the implementation phase. The intent is to balance the need for flexibility to adapt to on-the-ground realities, while ensuring adequate sideboards to minimize or avoid impacts to important resources. Below are some examples of how we would address maintenance of bridge habitat through the implementation guide.

Implementation guide—MSO guidance: Several features of the implementation guide treatment design for the MSO would serve as a proxy for other canopy-dependent wildlife. Design features for the owl are too numerous to list here, but those listed below serve to illustrate specifically how bridge habitat would be maintained at the mid-scale:

- Each PAC has a 100-acre, no treatment area around the known nest or roost sites.
- Each PAC to be thinned would have an upper diameter limit of trees that may be cut.
- Manage for 110 to 150 square feet of basal area in protected and target/threshold habitats, and 70 to 90 square feet basal area in restricted other habitat.
- Individual trees and tree groups would occupy approximately 60 to 75 percent of the area within restricted other habitat.
- Treatments are designed to manage for old age trees to sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation plan.
- No trees larger than 24-inch d.b.h. would be cut.
- In restricted other habitat, tree groups on average would range in size from 0.1 to 1 acre with northerly aspects and highly productive microsites having larger average group sizes.
- In restricted other habitat, manage for tree groups with different age classes by retaining individual and clumps of vigorous ponderosa pine seedlings, saplings and poles within the larger mid-aged, mature, or old tree groups.
- In restricted other habitat, interspace width between tree groups would average from 25 to 60 feet with a maximum width of 200 feet.
- Manage for large oaks and pine snags.

Table 161. Design features, BMPs, and mitigation measures contributing to bridge habitat

Species/Resource	Description
Bald Eagle Nests	No mechanical treatments would occur within a 300-foot radius of bald eagle nest trees.
Bald Eagle Roosts	No mechanical treatments will occur around confirmed bald eagle roost sites (300′ radius around roosts on the Coconino NF and a 10-chain radius on the Kaibab NF).
VSS 4, 5, and 6	Within group density – Manage mid-aged tree groups for a range of density and structural characteristics by thinning approximately 50 percent of the mid-aged groups to the lower range of desired stocking conditions, approximately 20 percent each to the middle and upper range of desired stocking conditions, and approximately 10 percent remain unthinned. Within group structure – Enhance and maintain mid-aged, mature, or old group structure by retaining individual and clumps of vigorous ponderosa pine seedlings, saplings, and poles within the larger group.
Caves and Sinkholes	A 300-foot, no mechanical treatment buffer unless mitigated by logical topographical breaks would be designated around cave entrances and sink hole rims to protect cave ecosystems and reduce disturbance to bats.
Dependable Waters	Hiding cover would be maintained near dependable waters by not targeting drainages for interspaces and openings and through implementation of watershed BMPs.
Great Blue Herons	No dominant or codominant trees would be cut in rookeries. Nest trees will be prepped prior to prescribed burning.
MSO	Trees greater than 24-inch d.b.h. would not be harvested.
Mixed Conifer	4FRI activities would not include mechanical or fire treatments in the mixed conifer inclusions within the ponderosa pine forest (e.g., nest and roost buffers in Bear Seep and Red Raspberry PACs). Similarly, islands of ponderosa pine within mixed conifer forest would not be treated as part of this project.
Northern Leopard Frogs	A no-treatment buffer (no thinning, no direct ignition) ¼-mile distant from tanks in the vicinity of known northern leopard frog sites, or a buffer designated along logical topographic breaks.
Northern Leopard Frogs	A 200-ft protection zone (100 feet either side of stream course) would be established around designated stream courses for northern leopard frogs. There would be no thinning and no direct ignition of prescribed burning within the protection zones. Designated skid trail crossings through the buffer zones are allowed.
Raptor Nests	No mechanical treatment buffers would be designated around raptor nests. Sharp-shinned hawk nests = 10 acres, Cooper’s hawk nests = 15 acres, osprey nests = 20 acres, other raptors = 50 acres.
Snags	Emphasize retention of snags ≥18-inch d.b.h.
Snags	Retain trees ≥18-inch d.b.h. with dead tops, cavities, and lightning strikes wherever possible to provide cavity nesting/foraging habitat (i.e., the living dead).
Streamside Management Zones	On areas to be prescribed burned, establish filter strips (also known as streamside management zones). Applies to riparian and nonriparian stream courses. Deferral widths range from 35 to 120 feet on each side of the stream course.
Turkeys	Retain medium to high canopy cover in pine stringers in the pinyon-juniper transition zone and target low-severity burns to retain yellow pine and roosting cover.

Species/Resource	Description
Wildlife Cover	Gambel oak, juniper, and pinyon species may only be cut as necessary to facilitate logging operations (skid trails and landings) and by design as follows: Within UEA, IT, SI, and WUI treatments, pinyon/juniper seedling/sapling and young/mid-aged trees may be cut within a 40-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation strategy). Within savanna and WUI PJ mechanical treatment areas, pinyon/juniper seedling/sapling and young/mid-aged trees may be cut.

Implementation guide—northern goshawk habitat guidance: Several features of the treatment design for the northern goshawk would serve as a proxy for other canopy-dependent wildlife. Design features are too numerous to list here, but a key few are highlighted to illustrate how bridge habitat would be maintained. Relevant design features from table 161 are not repeated below.

- Treatments are designed to manage for old age trees, following the old tree implementation plan.
- Treatments would strive to attain an overall stand average density ranging from 40 to 90 square feet of basal area and 15 to 40 percent of maximum SDI. Density would vary within this range depending on treatment type, intensity, and existing stand structure.
- Tree group density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature.
- To achieve overall stand average density targets, basal area and SDI within tree groups would often need to exceed the average target. Table 162 illustrates how this could work for basal area (see the implementation guide for greater detail). For example, a unit with a treatment intensity of 10 to 25, with an objective of 20 percent interspace and 80 percent treed, with 70 percent of treed area as groups and individuals and 10 percent as regeneration, and an overall target basal area of 60 would require the tree groups to average 86 basal area.
- Within group structure specific to mid-aged to old classes (VSS 4 to 6) includes open understories, interlocking tree crowns, abundant large limbs, and shade.
- Tree groups, on average, would range in size from 0.1 to 1 acre. Overall average group size would vary within this range depending on existing stand structure and pre-settlement tree evidence.
- Maximum interspace width of 200 feet.
- Maximum regeneration opening size of 4 acres or 200 feet wide.
- One group of reserve trees, three to five trees per group, would be left in created regeneration openings larger than 1 acre in size.
- Manage for large oaks.
- Within the proposed ADGF research areas, tree group size is dependent on experimental design and would range in size from 1 to 15 acres.

Table 162. Excerpt from section D of the 4FRI implementation guidelines

Treatment Intensity	Percent of Area		Percent of Area with Tree Cover		Average Group Basal Area to Achieve Overall Basal Area					
	Inter-space	Tree	Groups & Individuals	Regen-eration	40	50	60	70	80	90
10–25	**10**	**90**	90	0		56	67	78	89	100
			85	5		59	71	82	94	
			80	10		63	75	88	100	
			75	15		67	80	93	107	
			70	20		71	86	100	114	
	15	**85**	85	0		59	71	82	94	106
			80	5		63	75	88	100	
			75	10		67	80	93	107	
			70	15		71	86	100	114	
			65	20		77	92	108	123	
	20	**80**	80	0		63	75	88	100	113
			75	5		67	80	93	107	
			70	10		71	86	100	114	
			65	15		77	92	108	123	
			60	20		83	100	117	133	

In summary, bridge habitat would be managed for at the mid-scale in four key ways:

1. Desired conditions that strive to attain the full range of natural variability which would include areas for canopy-dependent wildlife,
2. Design features/BMPs/mitigation measures that result in a well-distributed mosaic of small-scale deferrals in an otherwise mechanically treated landscape,
3. Implementation guidance for MSO habitat that retains higher forest density and canopy cover relative to the surrounding landscape, and
4. Implementation guidance for the northern goshawks that allows for higher density within tree groups given the contribution of interspaces and openings to overall stand averages.

Conclusions About Bridge Habitat in the 4FRI Project

Closed-canopy, high-density forest conditions are currently common in the 4FRI project area. To achieve ecological objectives and modify landscape-scale fire behavior, prevalence of those dense forests must be significantly reduced. Given the evolutionary history of canopy-dependent wildlife on this landscape, we can assume that closed-canopy conditions were present within the natural range of variability. The question of how much of the pre-settlement landscape was in this condition remains unanswered, but the literature suggests that this was not the predominant condition. Nevertheless, it is the intent of the 4FRI project to provide bridge habitat for canopy-dependent wildlife to span the time between restoration treatments and achievement of desired conditions.

Potentially 13 percent of the landscape within the 4FRI project boundary would be deferred from treatment. Nearly 42 percent of the ponderosa pine treatment area would remain in a moderately closed to closed condition after treatment. Seventeen percent would remain in closed condition after treatment. Restoration units near the Mogollon Rim would provide the greatest percentage of bridge habitat after treatment. Old growth allocations account for 38 percent of the ponderosa pine treatment area and are well distributed across the landscape. A patch-mosaic of small deferrals would be created all across the 4FRI project area to provide safeguards for wildlife features such as nests and hiding cover. Implementation guidance in MSO and northern goshawk habitats includes provisions for higher density and canopy cover relative to the surrounding landscape. It is our assumption that all of these measures would provide adequate bridge habitat for canopy-dependent wildlife. Monitoring would be an important test of this assumption, and adaptive management would be employed if outcomes prove otherwise.

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