United States
Department of
Agriculture

Forest
Service

June 2005

**Southwestern
Region**

Environmental Assessment

Twin Prescribed Burn

Williams Ranger District, Kaibab National Forest
Coconino County, Arizona

Information Contact: Ariel Leonard, NEPA Planner
742 S. Clover Road
Williams, AZ 86046
aleonard@fs.fed.us
928-635-5614

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, sexual orientation, or marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TTY).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 1400 Independence Avenue, SW, Washington, DC 20250-9410 or call (202) 720-5964 (voice and TTY). USDA is an equal opportunity provider and employer.

Printed on recycled paper – June 2005

Content

Chapter 1 – Purpose and Need **1**
Document Structure 1
Introduction 1
Purpose and Need for Action 2
Current Condition 3
Desired Condition 3
Proposed Action 5
Decision Framework 5
Public Involvement 6
Concerns 6

Chapter 2 - Alternatives **8**
Alternative 1- No Action 8
Alternative 2- Proposed Action 8
Mitigation Measures Specific to the Proposed Action Alternative 11
Monitoring Specific to the Proposed Action Alternative 14

Chapter 3 - Environmental Effects **17**
Fuels and Fire Behavior Analysis 22
Air Quality 28
Overstory Vegetation 32
Wildlife 35
Threatened, Endangered, Proposed, and Sensitive Plants 55
Noxious Weeds 58
Range and Understory Vegetation 60
Watershed and Soils 61
Heritage 65
Recreation and Scenic Resources 66
Environmental Justice 72

Chapter 4 - Consultation and Coordination **75**
Literature Cited 77
Glossary 80

List of Tables

Table 1. Summary of estimated key effects for the Twin Prescribed Burn Project……17
Table 2. Dead woody debris by size-class for initial entry and maintenance burn areas in the Twin project area…….…….....……..21
Table 3. Potential behavior and conditions of wildfire for the No Action and Proposed Action alternatives at 5, 20, and 40 years post treatment……..……..…23
Table 4. Estimated Cumulative Effects of the Proposed Action on Wildlife Habitat Features and Trends, and Wildlife Species…….51
Table 5. Forest Service Region 3 Sensitive Plant Species that may occur on Williams and Tusayan Districts of the Kaibab National Forest……...…..55
Table 6. ROS class acres in the Twin Burn Project area…….64
Table 7. Scenic Integrity Objective (SIO) acres in the Twin Prescribed Burn project area…66

List of Figures

Figure 1. Vicinity Map of the Twin Prescribed Burn Project ……..2

Figure 2. Map of Proposed Action for the Twin Prescribed Burn……...10

Figure 3. FVS representation of the initial stand conditions used in the simulation……..…22

Figure 4. Arizona Smoke Management Airshed Map…….....29

Chapter 1 – Purpose and Need

Document Structure

The Forest Service has prepared this Environmental Assessment in compliance with the National Environmental Policy Act (NEPA) and other relevant federal and state laws and regulations. This Environmental Assessment discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and the no action alternative. The document is organized into four parts:

- Introduction: The section includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- Comparison of Alternatives: This section provides a detailed description of the agency's proposed action for achieving the stated purpose. The proposed action was developed based on comments received by the public and other agencies. This discussion also includes mitigation measures.
- Environmental Effects: This section describes the environmental effects of implementing the proposed action and the no action alternative. This analysis is organized by resource area. Within each section, the affected environment is described first, followed by the effects of the No Action Alternative that provides a baseline for evaluation and comparison to the proposed action.
- Agencies and Persons Consulted: This section provides a list of preparers and agencies consulted during the development of the environmental assessment.
- Appendices: The appendices provide more detailed information to support the analyses presented in the environmental assessment.

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

Introduction

The Williams Ranger District proposes to conduct prescribed fire treatments and associated activities to reduce hazardous fuels within the Twin Prescribed Burn Project area. The planning area encompasses approximately 14,900 acres of national forest system lands, including lands adjacent to private property. The project area is a band at the southern base of Bill Williams Mountain, extending to the southwest. It is located in T21 N, R1 E, Sections 1-3, 10-15, 22-27, and 33-36; T21 N, R2 E, Sections 15, 16, 18-22, and 27-30; and T20N, R1E, Sections 1-4, 9-16, and 21-23. The project boundary primarily falls in Ecosystem Management Area (EMA) 2, with a small portion of EMA 22. The project is in Arizona Game and Fish Department Game Management Unit 8, and includes a portion of the Hat Range Allotment. See Figure 1. Project Vicinity Map.

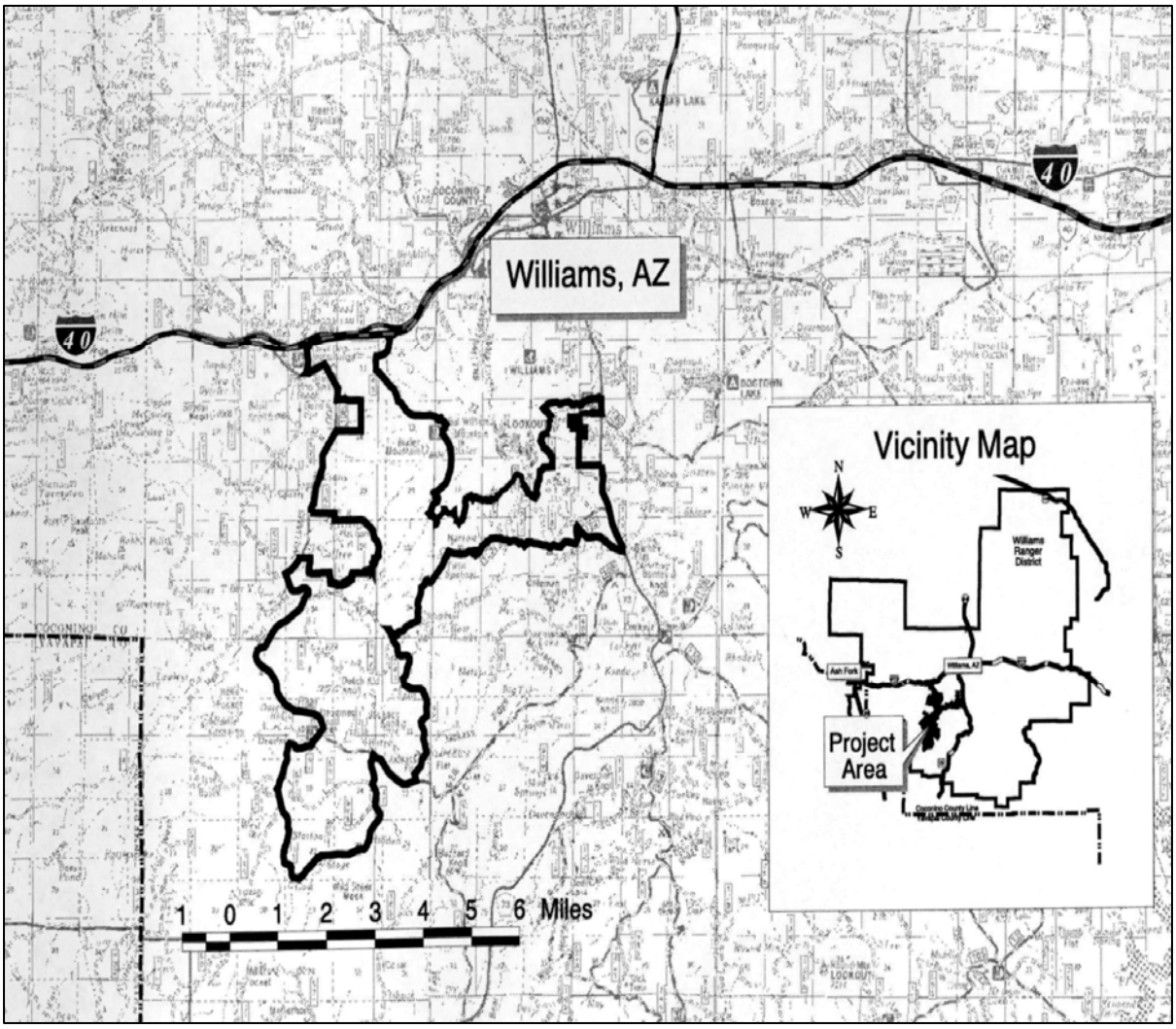

Figure 1. Vicinity Map of the Twin Prescribed Burn Project.

Purpose and Need for Action

There is a need to reduce the risk for uncharacteristically intense stand-replacement wildland fires, prevent the spread of wildland fire onto private property and into the City of Williams watershed, and to provide for firefighter and public safety in wildland fire situations. This action is needed because the potential for high intensity wildland fire within the Twin project area is high. Accumulations of dead and down woody debris, "ladder fuels," and unnaturally high tree densities have contributed to increased wildland fire potential. The proximity of these high fuel levels to private land and Bill Williams Mountain make the Twin project area a high priority for prescribed fire treatments.

This action responds to the goals and objectives outlined in the Kaibab Forest Plan (USDA Forest Service 2004), the Williams District Fire Risk Assessment (USDA Forest Service 1997), and the National Fire Plan's 10-Year Strategy (USDI and USDA 2001). This proposal would help to move the project area towards desired conditions described in these documents. This project meets the Forest Service's Southwestern Region definition for the wildland-urban interface

(WUI) which includes "those areas of resident populations at imminent risk from wildfire, and human developments having special significance. These areas include critical communications sites, municipal watersheds, high voltage transmission lines …and other structures that, if destroyed by fire, would result in hardship to communities. These areas encompass not only the sites themselves, but also the continuous slopes and fuels that lead directly to the sites, regardless of the distance involved" (FSM 5100, Chapter 5140, R3 Supplement No. 5100-2000-2, 12/22/2000).

Current Condition

The northern portion of the project area is a ponderosa pine forest, and the southern third is a transitional pinyon-juniper woodland. Some Douglas fir, white fir, southwestern white pine, and aspen occur on the northern aspects and higher elevation slopes. The project area provides habitat for a variety of wildlife and plant species, including the federally threatened Mexican spotted owl, sensitive species such as the northern goshawk and the peregrine falcon, other birds of conservation concern, and game species such as turkey, pronghorn antelope, mule deer, and Rocky Mountain elk.

The project area includes approximately 7,500 acres that were treated with prescribed fire between 1995 and 2001. These treatments significantly reduced forest floor duff and litter depths. The arrangement of dead and live fuels resulted in varying burn intensities over the project. Mortality of the large overstory trees was low, but in some areas with dense small-diameter trees, there were pockets of higher mortality. These areas of mortality helped to meet the project objectives by reducing stand densities and creating forest openings. However, many of the fire-killed trees have now fallen and become 4-to-8-inch diameter logs. The fuel load in these burned areas generally ranges from 2 to 15 tons per acre, with most of the higher fuel loads occurring in the pockets of mortality.

Approximately 7,400 acres of the project area has not been treated before, and most of it has not experienced fire in the last 100 years. Because fire has been excluded from the area for so long, existing live and dead fuel loads are unnaturally high. When ignitions occur under these conditions, fires burn with more intensity and have longer flame lengths than they would have 150 years ago. High-intensity fires can drastically alter wildlife habitats, displace species, cause irreversible soil erosion, decrease visual and scenic qualities, destroy heritage resources, and enable the establishment of noxious weeds.

Below-average precipitation over the last decade has resulted in an increase in bark beetle activity in some parts of the district. Bark beetles have killed groups of ponderosa and pinyon pine within the Twin project area. Currently moderate to severe bark beetle infestations are estimated to cover approximately 20% of the project area. Beetle-killed trees have contributed to the high levels of dead fuels in the planning area, especially in the area around Bixler Saddle.

Desired Condition

The Twin Burn project area was rated as a high priority for treatment in the Williams Fire District Risk Assessment (USDA Forest Service 1997). It falls within the Williams South Opportunity Area, which describes the following treatment zones and their desired conditions.

Intensive Treatment Zone

The intensive treatment zone is defined as the area within ⅛ of a mile of the northern and eastern project boundaries, and private land. Approximately 2,700 acres of the Twin Prescribed Burn Project are in the intensive treatment zone. This zone is considered the last line of defense against an advancing fire threatening private property.

The desired condition for the intensive treatment zone includes individual trees or small groups of trees that are widely spaced so crowns are separated. There are older "yellow-bark" ponderosa trees present, and large openings are interspersed between groups of larger trees. There is minimal dead and down woody material, including needles, and relatively few "ladder fuels" which consist of small logs, low branches, witches' brooms, saplings, and pole-sized trees. The objective in this zone is to increase firefighter and public safety, and reduce the risk of escaped fires.

Area Outside Intensive Treatment Zone

This area describes the rest of the project area, extending beyond the intensive treatment zone. The desired condition for this zone is one where there are low volumes of dead and down woody material. Trees vary in age and density, and occur as a vegetative mosaic interspersed with openings. Stand densities are typically higher than in the intensive treatment zone, but are much lower than current conditions.

Kaibab Forest Plan Management Direction

The Kaibab Forest Plan contains the following direction relating to the proposed project:

- Encourage prescribed fire and "wildland fire-use for resource benefit" (lightning caused) to reduce hazardous fuel accumulation. Thinning from below may be desirable or necessary before burning to reduce ladder fuels and risk of crown fire.
- Treat fuel accumulations to abate fire risk.
- Do not allow fires to spread to lands of other ownership.
- Protect human life and improvements.
- Minimize acreage burned by high intensity fires.
- Maintain soil productivity and watershed condition.
- Use prescribed fire as a resource management tool where it can effectively accomplish research objectives.
- Improve wildlife habitats through…development of habitat quality and diversity, and the identification and protection of key habitats.

National Fire Plan Direction

- Reduce the total number of acres at risk to severe wildland fire.
- Ensure communities most at risk in the wildland-urban interface receive priority hazardous fuels treatment.
- Expand and improve integration of the hazardous fuels management program to reduce severe wildland fires to protect communities and the environment.

Proposed Action

The Williams District proposes to thin, prune, and pile burn fireline preparation areas, reburn areas previously treated with prescribed fire (1995-2001), and introduce prescribed fire to untreated areas. These treatments would improve protection to private property, the City of Williams' watershed, and habitat for threatened and sensitive wildlife species from wildland fires. This action is intended to extend and maintain existing fuelbreaks created by the earlier burns, and to reduce the probability of wildland fire ignitions becoming intense stand-replacement fires. The following objectives were identified for the Twin Prescribed Burn Project:

- Provide for firefighter and public safety in wildland fire situations.
- Reduce the potential of wildland fire to enter private property from the Forest.
- Reduce the risk for uncharacteristically intense stand-replacement wildland fires by creating openings in the forest canopy, reducing forest fuel loads (dead and down woody debris), reducing ladder fuels (includes increasing the distance from the ground to lower live tree branches), and lowering tree densities.
- Protect wildland watershed condition and soil productivity. Prevent the spread of high-intensity wildland fire into the City of Williams watershed.

Specific tree mortality objectives:

- Mortality of “yellow” ponderosa pine would not exceed 5% across the project area.
- Mortality in black-bark ponderosa pine greater than 12 inches dbh would be less than 10%.
- Mortality of Gambel oaks greater than 5 inches dbh would not exceed 15%.
- Mortality of 5 to 12 inch dbh black-bark ponderosa pine would range from 5 to 30%.
- Mortality of ponderosa pine seedlings would be between 50 and 90% inside the intensive treatment zone, and from 10 to 60% outside the intensive treatment zone.

The initial prescribed underburning of the project area would occur over a five to seven year period following the date of a signed decision document. In order to maintain an effective fuelbreak and further reduce the risk of stand-replacement wildland fires, maintenance or “re-entry” burns may occur within a 10-year period following the decision date. However, prior to implementation of maintenance burns, the Project Environmental Assessment would be re-evaluated to determine if additional significant issues have arisen or significant changes have occurred in the project area. If there are no significant issues and conditions are not markedly different, the original decision would be validated and the maintenance burning would proceed.

There are no timber sales or commercial thinning operations under this proposed action. No new road construction, road closures, or road obliterations are being considered as part of the proposed action. Therefore, a roads analysis process will not be undertaken for this project.

Decision Framework

Given the purpose and need, the deciding official reviews the proposed action and the other alternative in order to decide whether to 1) defer action; 2) approve the proposed action; or 3) require additional analysis and development of new alternatives.

Public Involvement

This project was placed on the Kaibab National Forest's Schedule of Proposed Actions in January 2001, and has been listed quarterly since. The initial project proposal was sent out to the public and other agencies for scoping and comment on June 25, 2004. A final proposed action was sent out for a 30-day comment period on March 10, 2005. As part of the public involvement process, consultation was conducted with American Indian tribes in the area. Also, the Arizona Game and Fish Department (AGFD) has been involved in planning throughout the process (PR# 10, 12, 18, 25, and 39).

Concerns

During the initial scoping period, thirteen comments were received (PR# 46, 48, 49, 50, 51, 52, 53, 54, 55, 57, 58, 60, and 61). No substantive comments were received during the 30-day comment period. Using the comments received during initial project scoping, the interdisciplinary team identified the following concerns:

1. Prescribed burns have an inherent risk of escape.

Although there is an inherent risk when implementing prescribed burns, the District reduces this risk by implementing prescribed burns when weather and fuel conditions are favorable, monitoring weather regularly during burn implementation, and ensuring that adequate firefighting resources are available. A test burn (less than ½ acre) is conducted within 24 hours of ignition of all underburns to assess acceptable fire behavior and achievement of objectives. Each day, prior to ignition, the District Ranger and the Burn Boss each sign off on a daily review that conditions are favorable and an acceptable level of risk exists.

2. Prescribed burns create smoke that can irritate lungs and cause property damage.

Burns are implemented when there is good ventilation under an approved "burn plan." Each day of burning is coordinated with and approved by Arizona Department of Environmental Quality. Although burns are conducted when ventilation is good, smoke from burns may linger for few days, especially in low-lying areas. To reduce negative impacts to smoke sensitive individuals, public notification is given prior to burning as outlined in the Twin Public Information Plan (PR #11).

3. Prescribed burn activities can provide opportunities for noxious weeds to become introduced and established.

During the initial project development, mitigation measures were developed to prevent the establishment and spread of noxious weeds. They provide for pre-burn and post-burn surveys and weed control measures as needed. The mitigations were scoped as part of the Proposed Action. See "Mitigation Measures Specific to the Proposed Action" for Noxious Weeds (page 14).

4." Slash" from fresh cut trees (thinning) has the potential to attract bark beetles and kill trees on adjacent private lands.

Thinning is proposed in the fireline preparation area totaling up to 355 acres. This area is a narrow band of up to 130 feet in width, and would not result in heavy concentrations of activity slash. In order to further reduce the potential for bark beetle infestations, thinning will be avoided between the dates of January 1 and July 1, especially when adjacent to private land. If these dates cannot be avoided, other methods of reducing bark beetle infestation risk will be considered such as removing the slash from the site or chipping.

5. Fire can kill large old trees.

This concern was addressed during the initial phases of project planning. Mitigation measures were developed for the protection of large trees and were scoped as part of the Proposed Action. See "Mitigation Measures Specific to the Proposed Action" for Wildlife and Habitat (page 11).

6. Fire can ignite and consume snags and down logs which are key wildlife habitat components.

This concern was addressed during project development. Mitigation measures were developed for the protection of snags and down logs and were scoped as part of the Proposed Action. See "Mitigation Measures Specific to the Proposed Action" for Wildlife and Habitat (page 11).

7. Fireline created by dozers is aesthetically unattractive.

Slash created by fireline preparation within two chains of trails, sensitive roads, and private residences will be hand piled. Additionally, dozer lines and piling will be minimized in fireline preparation areas adjacent to private property.

8. Dozer piling can cause soil compaction and erosion.

All dozer lines will be rehabilitated after implementation. Additionally, mitigation measure #26 was modified to read "Safety Zones and dozer lines will be evaluated to determine whether erosion control measures, such as waterbars, berms, and/or seeding are needed."

NOTE: Mitigation actions discussed above that are not formally incorporated into the proposed action mitigation measures (p. 11-15) are specified in the implementation plan.

Chapter 2 - Alternatives

During project scoping and the 30-day Notice and Comment period, no significant issues were raised; as a result, no additional alternatives were developed. The final proposed action that was sent out for 30-day review and comment was developed to meet the purpose and need and contained modifications designed to address public concerns. This chapter describes the "no action" and the "proposed action" alternatives considered for the Twin Prescribed Burn Project.

Alternative 1- No Action

Under the "No Action Alternative," no prescribed burning or thinning would be implemented to accomplish project goals.

Alternative 2- Proposed Action

The following thinning and burning treatments were developed to meet the project objectives for different areas. Prescribed burning will be accomplished using a combination of ground and aerial ignition. Aerial ignition may be used to ignite prescribed fire throughout the Twin project area. Aerial ignition is sometimes preferred because it generally results in improved firefighter safety, improved smoke management, and lower implementation costs. Aerial ignition is preferred in areas where rugged terrain and exposure could lead to firefighter injury. Ground ignition is generally preferred when the risk and consequences of escape are high (e.g. adjacent to private property). For treatment locations, see Figure 2, "Map of Proposed Action."

Area A: Maintenance Burning (7,500 acres)

This area would be treated with "maintenance burns." This involves reburning areas that had prescribed fire treatments applied from 1995-2001. In order to maintain the fuelbreak created by the earlier burns, these areas will be treated through underburning or jackpot burning. Most of the higher fuel loads in these areas are made up of 4-to-8-inch diameter logs. All burning will be conducted to meet project objectives under prescription parameters identified in the prescribed burn plan. The intent of the proposed burn is to reduce fuel loading, raise crown base heights, and reduce live tree density so that severe fire behavior and potentially damaging fire effects are significantly reduced.

Area B: Initial Prescribed Burning (7,400 acres)

Fire treatments are proposed on these areas of the forest that have not been treated previously. Most of this area has not experienced fire in the last 100 years. Initial and re-entry burning will be conducted under the prescription parameters identified in the prescribed burn plan. The intent of the proposed burn is to reduce fuel loading, raise crown base heights, and reduce live tree density so that severe fire behavior and potentially damaging fire effects are significantly reduced.

Area C: Fireline Preparation/Tree Thinning (355 acres)

Prior to prescribed burning, the project boundary adjacent to the slopes of Bill Williams (see area C, sections 16 and 18-21) and the private property boundaries near Hat Ranch, Quarter Circle XX Ranch, and Benham Ranch would receive fireline preparation up to 130 feet from the control lines. This treatment would reduce the risk of escape during prescribed burning activities, and improve protection of these areas. The intent of the action is to reduce and rearrange forest fuels

to decrease fire intensity and rate of spread near critical areas. This would decrease the risk of escape and increase protection of uphill and downwind critical areas from fire. Fireline preparation would be accomplished using chainsaws and hand tools. Preparation would involve thinning trees and treating slash to the following specifications:

- Thin all ponderosa pine and fir trees less than 9 inches diameter at breast height (dbh).
- Prune all trees greater than 9 inches dbh up to 6 feet in height.
- Material created by these treatments would be piled and subsequently burned when conditions are appropriate. Hand piling would take place within two chains (132 feet) of trails, sensitive roads, and private residences. Dozer piling would occur along dozer lines (270 acres).

Some areas along the north and east project boundaries may also receive the preparatory treatment where the risk of escape can be reduced through treatment. Due to limited resources, not all areas shown in "Area C" on the map may receive this treatment. Several factors would be considered when prioritizing areas for fireline preparation including adjacent values at risk, fuel loading, "jackpot conditions", ladder fuels, resistance to control, topography, aspect, prevailing winds, and "spotting" potential.

Area D: Intensive Treatment Zone (2,700 acres)

All available fuels would be ignited where possible. Logs and snags are sources of intense heat and firebrands which could spot across control lines. The intent of this action is to consume all available fuels to reduce the risk of future fire behavior problems. In order to provide increased protection to private lands, improve firefighter safety, and reduce the risk of fire escape during project implementation, some wildlife mitigation measures relating to snag and down log protection would not apply within 660 feet of private property boundaries, or within 660 feet of the north and east project boundaries (see Mitigation Measures 9, 10, and 11).

Safety Zones (27 acres)

Safety zones would be constructed in 11 locations in order to provide safe areas for firefighters to retreat to in the unlikely event that fire threatens them. Safety zones are generally areas up to 272 feet by 400 feet (2.5 acres) where dead fuels and live trees up to 9 inches dbh are removed, and trees greater than 9 inches dbh are pruned up to 6 feet in height. Vegetation material that is cut or pruned will be piled and burned. Ponderosa pine seedlings and saplings that are spaced 30 feet by 30 feet, or greater, may be retained where practical. These areas burn with less intensity and provide a safe area for firefighters in the event of an entrapment. The intent of this action is to provide for increased firefighter safety.

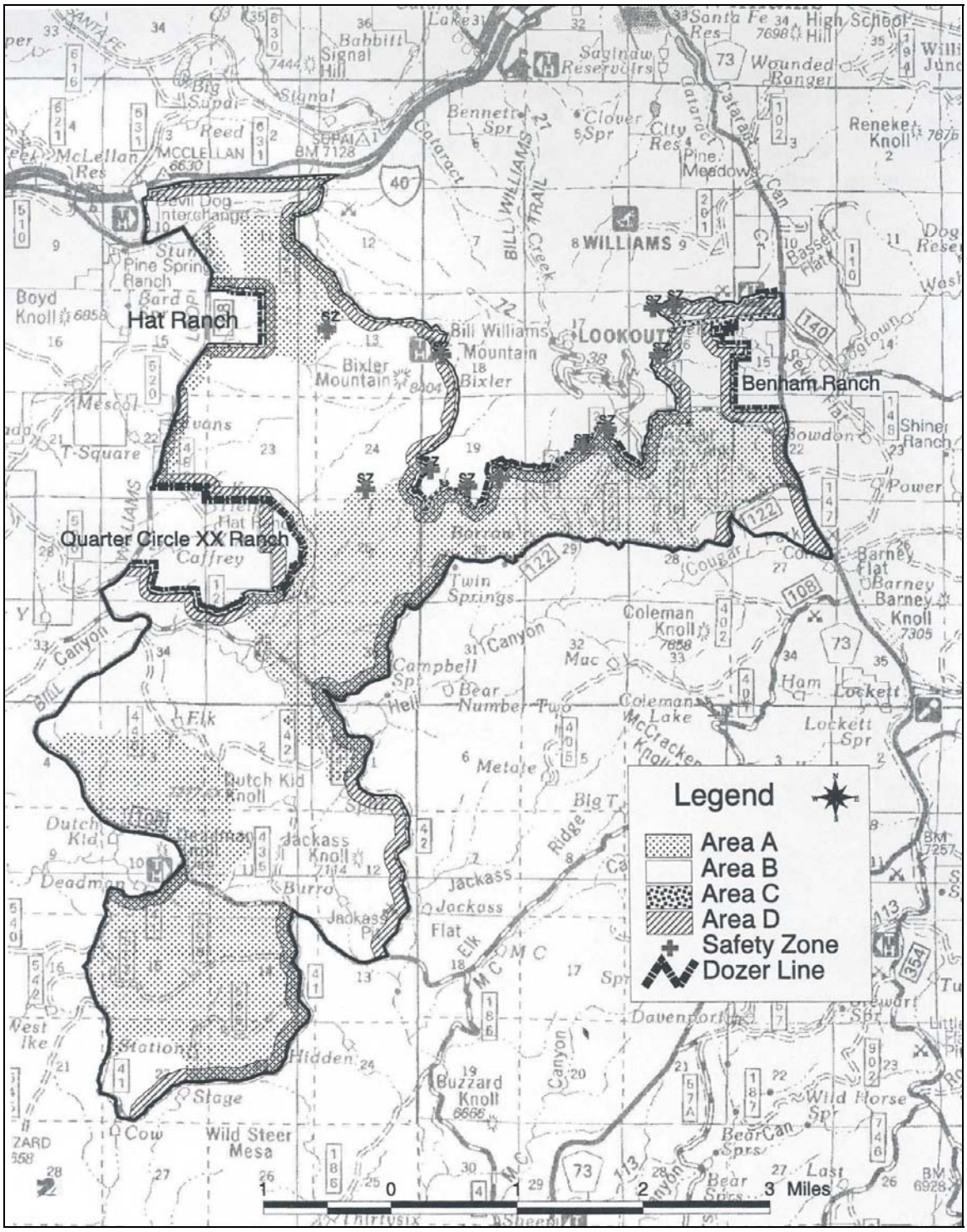

Figure 2. Map of Proposed Action for the Twin Prescribed Burn.

Mitigation Measures Specific to the Proposed Action Alternative

Mitigation measures are steps taken to minimize potential negative impacts that may occur due to implementation of the proposed action, as well as to protect key habitat features. The following are mitigation measures developed for the proposed action:

Scenic Resources and Recreation Sites

1. All evidence of all terrain vehicle (ATV) use, as appropriate under emergency situations as a result of the project, on the Benham Trail, and mechanical line construction on or crossing system trails (Benham Trail, Route 66 Mountain Bike Trail) will be rehabilitated post-implementation.
2. All new and reopened dozer lines and roads will be rehabilitated after implementation.
3. The berms at the junctions of Forest Road (FR) 108 and Route 66 Bike Trail, and FR 473, and Route 66, will be improved after implementation.
4. The Fire/Fuels shop will spend one to two shifts post-burn removing dead scorched/browned trees from the visually sensitive areas in the Interstate-40 block under the direction of the District Recreation Specialist.
5. The closed road between FR 209 and the Benham Trail will ***not*** have vehicle use. ATV use will be limited to the bladed and upper trail end of this burn block boundary.
6. All recreation facilities and signs on roads, trails, and at trailheads will be protected from fire damage and other implementation activities. If necessary for protection, debris will be removed down to mineral soil for a distance of one to two feet away from the base of wooden recreation and trail improvements.
7. All stumps created from thinning will be cut to within 6 inches of the ground and will be slightly angled away from the Benham Trail.
8. Slash created by fireline preparation within two chains (132 feet) of trails, sensitive roads, and private residences will be hand piled.

Wildlife and Habitat

General

9. All snags $\geq$ 18 inches in diameter at breast height (dbh) and $\geq$ 30 feet tall, or greater than 9 inches dbh with a cavity (except within Area D, the intensive treatment zone, where greater fuel reduction is needed to adequately reduce risk) will be protected by a) avoidance of direct hand ignition, b) burning under cooler prescriptions, and/or c) removing debris down to mineral soil for a distance of one to two feet away from their base prior to ignition.
10. Direct hand ignition of down logs that are greater than 12 inches in midpoint diameter and 8 feet long will be avoided (except within Area D, the intensive treatment zone, where greater fuel reduction is needed to adequately reduce risk). Note that it is possible that aerial ignitions could cause direct ignition through the random dispensing of spheres. When possible, burning (especially aerial ignitions) will be done when logs have higher fuel-moisture contents.
11. Yellow pine and large oak protection: woody material and deep accumulations of needlecast (i.e., >6 inches deep) will be removed from the bases of large yellow ponderosa pines (>18 inches dbh) and large oak (>16 inches dbh) prior to prescribed burning. Test applications with retardant spray will also be conducted in selected areas outside protected Mexican spotted owl (MSO) habitat [i.e., outside of Protected Activity Centers (PACs) and protected steep slope habitat] where first entry burning is planned. If these applications are successful, retardant spray may be used in addition to, or instead of, material removal outside of protected MSO habitat.

12. A few large-diameter (≥18 inch dbh) snags or dying trees may become safety hazards along roads or power lines as a result of this project. To eliminate any such safety hazards, these snags or trees that will need to be felled will be left on the ground as logs to provide habitat for wildlife species except within Area D, the intensive treatment zone where greater fuel reduction is needed to adequately reduce risk. These logs may be moved away from roads and trails as necessary to minimize visual/aesthetic impacts.
13. To promote the closure and rehabilitation of Bixler Saddle Road south of Bixler Tank, as well as improving a wildlife water source, the tank is recommended for cleaning and lining with bentonite. The Arizona Game and Fish Department will request funding for tank repair funding through State habitat funding sources. Repairs will be made if funding is available.
14. Openings created by prescribed burning will be less than 4 acres in size and 200 feet in width, to the greatest extent practical. Exceptions may occur outside the intensive treatment zone where prescriptions include more moderate-intensity burns.

Northern Goshawk

15. Project-related activities (with the exception of prescribed burning as described in mitigation measure #16 below), such as pre-burn preparation and post-burn follow-up work, will be prohibited in northern goshawk (NOGO) nesting areas (i.e., previously delineated 30 acre areas) and post-fledging family areas (i.e., previously delineated 600-acre areas including three actual and three suitable nesting areas) within the project site during the breeding season. The NOGO breeding season extends from March 1 through September 30.
16. Low intensity prescribed ground-fire burning may occur within occupied NOGO nesting areas during the breeding season, with the following measures: a) a burn plan will be prepared; b) the burn plan will minimize risk of goshawk abandonment while low-intensity ground fire burns in the nesting area; and c) prescribed fire within the nesting area(s) will be planned to move with prevailing winds away from the nest tree to minimize smoke and risk of crown fire developing and driving the adults off or consuming the nest tree.
17. Burning of the entire home range of a goshawk pair during a single year will be avoided.
18. Debris from project-related activities will not be grappled or dozer-piled within NOGO nesting areas.

Mexican Spotted Owl

General Measures for All Protected and Restricted Habitat (i.e., Protected Activity Centers, protected steep slopes, and mixed conifer and pine-oak forests).

19. Woody material and deep accumulation (i.e., >6 inches deep) of needlecast will be removed from the bases of large ponderosa pines (>18 inches dbh) and large oak (>16 inches dbh) prior to prescribed burning.
20. Trees of any species with greater than 24 inches dbh will be retained to the greatest extent practicable by removing heavy accumulations of needlecast (>6 inches depth) around the base of these trees and avoiding direct hand ignition of these trees.
21. To monitor and report on the success of management activities in promoting maintenance and development of MSO key habitat components, pre- and post-treatment monitoring will be conducted within the protected and restricted MSO habitat within the project site. A streamlined monitoring protocol (Protocol A) specified in the *Region 3, 1998 Protocols for Implementation and Effectiveness Monitoring: Mexican Spotted Owl Microhabitat*, which were based upon the *Microhabitat Monitoring Protocol for the Mexican Spotted Owl* (U.S. Department of Agriculture; April 24, 1998) will be used.

Additional Measure for Protected Activity Centers (PACs)

22. Clumps of broadleaved woody vegetation (i.e., shrubs), and hardwood trees larger than 10 inches in diameter at the root collar (drc) will be retained within the PAC to the greatest extent practicable (except within 660 feet of the wildland-urban interface and/or north and east project boundaries where greater fuel reduction is needed to adequately reduce risk). To achieve this, the following measures will be taken within the proposed burn area within the PAC: a) direct hand ignition of these features will be avoided, and b) burning will be conducted during conditions with relatively high fuel-moisture content.
23. Project-related activities (e.g., pre-burn preparation, prescribed burning, post-burn follow-up, project-related vehicle use of Bixler Saddle Road) will be prohibited within the MSO PAC within the project site during the MSO breeding season, March 1 to August 31. Project-related vehicle use of Bixler Saddle Road within the MSO PAC will occur outside of the MSO breeding season (i.e., use will occur between September 1 through February 28) as necessary to help ensure safe project implementation.

Additional Measures for Protected Steep Slope Habitat – Mixed conifer and pine-oak forests outside MSO PACs with slopes greater than 40% that have not been logged within the past 20 years.

24. Clumps of broadleaved woody vegetation (i.e., shrubs), and hardwood trees larger than 10 inches drc will be retained within protected steep slope MSO habitat to the greatest extent practicable (except within 660 feet of the wildland-urban interface, and/or north and east project boundaries where greater fuel reduction is needed to adequately reduce risk). To achieve this, the following measures will be taken within these protected areas in the project site: a) direct hand ignition of these features will be avoided; and b) burning will be conducted during conditions with relatively high fuel-moisture content.

Soil and Watershed

25. Limit the use of heavy equipment during wet periods to avoid soil compaction and loss of productivity.
26. Safety Zones and dozer lines will be evaluated to determine whether erosion control measures, such as waterbars, berms, and/or seeding are needed.

Fire and Air Quality

27. Initiate prescribed burning when weather conditions are favorable for adequate control of fire, and when smoke management conditions are not likely to produce significant adverse impacts to smoke sensitive areas.
28. Plan for intra-agency pre-burn coordination and, where applicable, burn notification of appropriate media organizations; city, county and state agencies; internal Forest Service personnel; local businesses; forest permit holders; adjacent landowners; and other members of the public.

Noxious Weeds

29. Surveys for noxious weeds will be conducted throughout the project area during appropriate seasons for detection and identification. Pre-burn and post-burn surveys will be conducted and weed control measures will be taken as needed. Using the survey results, a Noxious Weed Risk Assessment will be completed. If necessary, a Noxious Weed Management Plan will be prepared.

30. Designate weed-free staging areas, as well as “no travel zones” to prevent traffic through weed-infested areas.
31. Remove mud, dirt, and plant parts from off-road equipment prior to bringing it on site.
32. Clean equipment that is used in infested areas during the project prior to entering other project areas. Designate a specific area for cleaning.

Sensitive Plants

33. If populations of sensitive species are found before or during project implementation, the project manager will coordinate with the district sensitive plant coordinator to restrict negative impacts.

Heritage

34. Archaeological surveys will be conducted in advance of unsurveyed bulldozer line.
35. An archaeologist or para-archaeologist will be contacted in the event that emergency firelines must be constructed with heavy machinery.
36. Heritage clearance will be obtained prior to <u>any</u> pile burning or any planned bulldozer work, including the Bixler Tank cleanout.
37. Firelines and Safety Zones must be surveyed prior to construction and heritage clearance obtained.
38. Heritage clearance will be obtained prior to removal of hazard trees along roads and power lines travel where hazard trees may be removed.
39. An archaeologist will be present at the pre-work “tailgate safety meetings” on an annual basis to discuss with crews the possibility of encountering additional unknown heritage resources (especially those with vulnerable features within the project area such as wooden structures or friable rock art).
40. Fire crews will report any unrecorded sites found within the project area to the archaeologist so that avoidance plans can be formulated.

Monitoring Specific to the Proposed Action Alternative

Implementation and effectiveness monitoring are conducted to determine if projects are implemented as planned, whether project objectives were achieved, and if management changes are needed. Monitoring specific for the Twin prescribed Burn project includes the following:

Mexican Spotted Owl Key Habitat Components

1. Implementation and effectiveness monitoring will be conducted to determine changes in key habitat components (snags, logs, and large trees) for the Mexican spotted owl. Plots will be monitored pre and post-treatment in accordance with Forest Service Region III “Protocol A.”

Dead Woody Debris Fuel Loading

2. Pre and post-burn monitoring will be accomplished using Brown’s Transect to determine the success of first-entry treatments. Successive maintenance burning will be monitored post-treatment to determine success.

Noxious Weeds

3. Monitoring guidelines described in the "Noxious Weeds Strategic Plan Working Guidelines" (Coconino, Kaibab, Prescott National Forests, 1998) will be followed. Monitor the project area for noxious weeds for at least three years following burning and fireline preparation treatments and control weeds as necessary.

Recreation and Scenic Resources

4. Within 2 years of project implementation, conduct site visit of a stratified sample of 1-2 locations in each Recreation opportunity Spectrum (ROS) class within the Project Area to evaluate whether resource management practices and mitigations are completed as specified. Revisit the sites 1 to 5 years after project completion to evaluate the effectiveness of treatments and mitigations toward meeting ROS objectives.

5. Within 2 years of project implementation, conduct site visit of a stratified sample of 1-2 sites per Scenic Integrity Objective (SIO) in the Project Area to evaluate whether resource management practices have met the SIO timelines and mitigations are completed as specified. Revisit the same sites after 1 to 5 years after project completion to evaluate the effectiveness of treatments and mitigations toward meeting SIOs.

Chapter 3 - Environmental Effects

Summary of Key Effects

This chapter summarizes the physical, biological, and social environments of the affected project area and the potential changes to those environments anticipated from the Proposed Action and No Action Alternatives. It also presents the scientific and analytical basis for the comparison of effects that are summarized in the chart below.

Table 1. Summary of estimated key effects for the Twin Prescribed Burn Project.

Environmental Effect	Alternative 1 – No Action	Alternative 2 – Proposed Action
Fuels and Air Quality		
Hazardous Fuels / Fire Risk	There would be no reduction in current fuel loads and fire risk. Fuel loading would increase over time, resulting in a higher probability of crown fires, torching, and longer flame lengths. Crown fires that are initiated in one stand could easily move to adjacent stands. Without prescribed fire treatments, fuel conditions would continue to build up, resulting in a landscape that is more susceptible to crown fires.	Long-term decrease in fire hazard due to reduced fuel loading that meets the desired fuel loading of 0-7 tons per acre. Reduction in ladder fuels; thereby, reducing the potential for torching, crown fires, and shorter flame lengths. Prescribed burning would provide a more natural mosaic of fuel conditions across the landscape that would inhibit crown fires. Some short-term increase in fire hazard in the fireline preparation areas until thinning slash is cleaned up. Short-term increase in fire hazard in pockets of deadfall from small-diameter fire-killed trees until after the reentry underburns occur.
Smoke / Air Quality	There would be no emissions or particulates from prescribed burns; however, large amounts of smoke could occur in the event of a wildfire. Smoke from wildfires would likely produce more emissions and last longer as both dead and live fuels are consumed.	Short-term smoke impacts on burning days during project implementation. Smoke emissions would be managed in accordance with ADEQ standards and guidelines. Smoke impacts would be managed to reduce effects.
Overstory Vegetation		
Tree Density	Tree densities would be retained (more than 450 trees per acre), gradually increasing over time. Tree growth rates and vigor in the project area would remain low, decreasing over time.	Tree densities would be reduced over time through mortality from prescribed burning, and reentries. Remaining trees would have more light, water, and nutrients resulting in healthier trees with increased growth.

Environmental Effect	Alternative 1 – No Action	Alternative 2 – Proposed Action
Vegetation Cover Types	Following successional pathways, some ponderosa pine-dominated stands would be converted to mixed conifer cover-types. More woodlands and grasslands would become pine-dominated as tree encroachment occurs. Some aspen stands would gradually be lost as they are overtopped by more shade tolerant species.	Maintains existing vegetative cover-types through reduced competition and mortality. Restores natural openings and meadows where tree encroachment has occurred.
Large Trees	Initially, the number of large trees (greater than 18 inches dbh) would remain the same. However, over the long-term, density related competition would result in the loss of some larger diameter trees from stress, and from increased risk of wildfire and bark beetle attack. Without treatments, medium-sized trees would continue to compete for limited resources and fewer medium-sized trees would grow into the larger diameter classes.	Initially, the number of large trees greater than 18 inches in diameter would be reduced by up to 5% from prescribed fire mortality. Remaining large trees would be less susceptible to mortality from fire, protecting them over the long-term. Over the long-term, some increase in diameter growth would result in shorter transition times for smaller trees growing into the larger diameter classes.
Vegetative Structure	Grassy forest openings would be lost over time through encroachment. Grasses, forbs, and shrubs in the understory would continue to decrease over time. Trees in the larger diameter classes would be lost from competition induced mortality, and would be at higher risk for loss from wildfires and bark beetle attacks. These effects would result in maintaining a more even-aged tree distribution.	New openings would be created that would promote grass, forb, and shrub production. It would also allow for the establishment of tree seedlings. Increased longevity and diameter growth would result in more large trees over the long term. These effects would contribute to the diversity of tree age and size-classes.
Insects and Pathogens	Stress associated with high tree densities would result in some trees being more susceptible to infestation by insects, disease, and other pathogens. The risk of epidemic levels of bark beetle infestation would remain high over time. Dwarf mistletoe infection levels would continue to increase.	Dwarf mistletoe infection levels would be reduced. Trees would have a lower risk of mortality from infestation by bark beetles and other forest pests, and infection with tree diseases. The risk of widespread bark beetle infestation would be reduced. In the intensive treatment zone, there is a short-term risk that fresh cut thinning slash may draw bark beetles into the area, possibly infecting and killing trees. This risk would be reduced by thinning treatment timing.

Environmental Effect	Alternative 1 – No Action	Alternative 2 – Proposed Action
Wildlife		
Mexican Spotted Owl and Northern Goshawk	Logs and snags would be retained. Habitat would be more susceptible to stand-replacing wildfires. No effect to Forest habitat or population trends for the goshawk or spotted owl.	Short-term reduction of logs and snags. Some trees will be killed from prescribed burns, resulting in some snags being created. Some increase in habitat for prey species associated with increased structural diversity. Large tree protection and a slight increase in tree growth rates would contribute to the number of larger trees over the long-term. Decreased potential for high-intensity wildfire and sudden loss of habitat. No effect to Forest habitat or population trends for the goshawk or spotted owl.
Pronghorn Antelope, Rocky Mountain Elk, and Mule Deer	Trees would continue to encroach into grasslands, reducing understory production and available forage and browse for wildlife. Habitat would be susceptible to loss from high intensity wildfire. No effect to Forest habitat or population trends for pronghorn, elk, or deer.	Low-intensity burning would create small forest openings and return nutrients to the soil, stimulating growth of understory forage and browse species. There would be a reduced potential for high-intensity wildfire. No effect to Forest habitat or population trends for elk, or deer. Slight increase in habitat and population trend anticipated for pronghorn.
Hairy Woodpecker, Pygmy Nuthatch, Tassel-eared Squirrel, and Turkey	No displacement of individuals, nest sites, or nest trees would occur. No improvement of forage availability. Potential loss of suitable nesting and foraging habitat from high-intensity stand replacing wildfire. No effect to Forest habitat or population trends for these species.	Individuals could be temporarily displaced during burning. Slight decrease in tree density, snag availability and canopy cover from prescribed fire treatments. Low-intensity burning would return nutrients to the soil, improving both the quality and quantity of forage. Reduced potential for habitat loss from stand replacing wildfire. No effect to Forest habitat or population trends for these species.
Rare and Sensitive Plants		
Arizona bugbane	Short-term: maintains beneficial shading. Long-term: vulnerable to catastrophic fire.	Short-term: no effect. Long-term: maintain population and habitat viability.
Mt. Dellenbaugh sandwort	Increased shading decreases vigor and reproduction; vulnerable to catastrophic fire.	Maintains required open canopy. Protection from catastrophic fire.
Rusby's milkvetch	Vulnerable to catastrophic fire.	Protection from catastrophic fire.

Environmental Effect	Alternative 1 – No Action	Alternative 2 – Proposed Action
Flagstaff beardtongue	Increased shading decreases vigor and reproduction; vulnerable to catastrophic fire.	Maintains required open canopy; Protection from catastrophic fire.
Noxious Weeds		
Noxious Weed Potential	No direct effect. Potential risk for creation of prime noxious weed habitat due to higher risk of intense stand-replacement wildfires that would create large areas of exposed soil.	Short-term exposed soil, which favors weed colonization. Mitigation measures assure noxious weeds are monitored and treated. Reduced potential risk for creation of extensive weed habitat due to reduced risk of high-intensity stand-replacement wildfires that would create large areas of exposed soil.
Range Vegetation		
Grass, Herb, and Shrub Diversity	Continued expansion of trees into grasslands and woodlands would cause decrease in herbaceous and shrub diversity and abundance; thereby, decreasing amount and quality of forage available for livestock. Downward trend in range condition likely. Increased potential for high intensity wildfire to consume herbaceous forage and browse species, with slow recovery.	Decrease in tree density and canopy cover in woodlands and grasslands lead to improvements in herbaceous and shrub cover and distribution, then increase in species diversity. Low-intensity burning would return nutrients to soil improving both the quality and quantity of forage and browse resources for wildlife and livestock. Decreased potential for high intensity wildfire and sudden removal of understory vegetation.
Soils and Watershed		
Soils and Watershed	No compaction of soils from equipment / machinery, such as dozers; no increase in exposed soil. Watershed vulnerable to extensive areas of bare, sterilized, hydrophobic soils in event of high intensity wildfire; loss of productivity.	Short-term increase in bare soil, possible compaction. Long-term stability or improvement due to improved herbaceous cover. Reduced risk of unsustainable soil erosion / loss of productivity from high intensity wildfire.
Heritage Resources		
Heritage Resource Sites	Fuels would continue to accumulate on heritage resource sites, making them more vulnerable to higher temperatures should wildfires move through the project area.	No adverse effects when mitigation and protection measures are followed. Reduced threat from uncontrolled wildfires on heritage resources due to fuels reduction in prehistoric sites, and low-intensity prescribed burning.

Environmental Effect	Alternative 1 – No Action	Alternative 2 – Proposed Action
Recreation Resources		
Outdoor Recreation Settings-Recreation Opportunity Spectrum (ROS)	No direct, short-term effects to Forest Plan ROS settings. Risk is higher under this alternative to maintaining desired ROS settings due to higher risks of long-term negative effects of uncontrolled wildfires.	Short-term negative effects on all ROS settings during project implementation are expected, but duration and intensity of effects will be minimized with mitigation. ROS setting quality will be restored once project completed and recovered to "undisturbed" appearance, expected to recover fairly in one season in Roaded Natural areas, recovery expected to last several seasons in semi-primitive ROS settings. Long-term protection of desired ROS would be better under this alternative due to lowered risk of uncontrolled wildfires.
Developed Recreation Sites and Facilities	No direct effects are expected to developed recreation facilities and sites under the No Action alternative. Risk is higher under this alternative of serious damage or loss of recreation sites and facilities due to higher risk of uncontrolled wildfires occurring in surrounding landscape.	Minor direct negative effects may occur to developed recreation sites during project activities but duration and intensity will be mitigated. This alternative better provides for long-term protection of developed sites and facilities by reducing the potential for uncontrolled wildfires.
Recreation Use and Activities	No direct, short-term effects are expected. There is a higher risk of losing quality and desirability of recreation settings and facilities, which would directly affect the public's ability to participate in desired recreation uses and activities in the area in the future.	Potential for short-term displacement or dissatisfaction (smoke) of recreation visitors during project implementation. Long-term ability to protect and maintain quality recreation settings and facilities would be enhanced under this alternative by reducing the potential for uncontrolled wildfires.
Scenic Resources		
Desired Landscape Character and Scenic Integrity	No direct effects to Existing Landscape Character. Ability achieve Desired Landscape Character is not improved. Under this alternative there is a higher risk of uncontrolled wildfires and other disturbances which would negatively affect achieving the Desired Landscape Character in the long-term.	Changes to Existing Landscape Character may be evident, but this alternative enhances ability to achieve and sustain the Desired Landscape Character because the potential for uncontrolled wildfires and their long-term negative effects is reduced.

Environmental Effect	Alternative 1 – No Action	Alternative 2 – Proposed Action
Scenic Integrity Objectives (SIOs)	No direct effects on achieving Forest Plan SIOs in the short-term. Higher risk of negative long-term effects from uncontrolled wildfires and other disturbance factors which would threaten the ability to meet Forest Plan SIOs over the long-term.	Visible effects of project implementation would not meet Forest Plan SIOs until slash is treated and control lines rehabilitated; however, mitigations will minimize extent and duration of negative impacts. This alternative would achieve Forest Plan SIOs shortly after implementation activities and mitigations are completed and a season or two of natural recovery has occurred.

Fuels and Fire Behavior Analysis

General Conditions

The fire environment is generally described in terms of topography, weather, and fuels. Within the Twin project area, slopes range from zero to 50%, with most slopes being 5 to 20%. All topographic aspects are present; however, the majority are facing southwest to southeast. Weather patterns in the Twin project area are typical of the southwestern moisture regime, with bimodal precipitation generally occurring January through March and July through August. The primary wind vectors are from south to west, and strong wind events are common March through June. Because fuels are the only part of the fire environment we can influence, the proposed action focuses on reducing potential fire behavior by reducing forest fuel loads (dead and down woody debris), reducing ladder fuels (includes increasing the distance from the ground to lower live tree branches), and lowering tree densities.

Dead Woody Debris

When surface fires burn through areas with high accumulations of dead woody debris (DWD), they generate more heat and increase the chance of a surface fire getting up into the crowns. Large logs make up the largest DWD size-class (9”+) and add significantly to DWD loading. They burn very hot for long periods of time, contributing to spotting problems and greater heat. They have higher flame lengths and longer burn durations that can dry out and ignite the live tree crowns above. Large logs do not have much impact on rate of spread; but they contribute to the likelihood that large trees may be killed. The smallest DWD size-class (0-3” diameter) has the greatest influence on rate of spread (Rothermel 1972). Prescribed burns usually reduce the smallest size-class to less than half the preburn value, resulting in slower spreading fires. Accumulations of duff and litter can also contribute to the mortality of large, old trees when fires occur (Sackett 1980).

In the Twin project area, DWD loads average about 3.5 tons/acre. DWD fuel loads vary, but are generally either unburned/initial entry areas or burned/maintenance burn areas. Project area fuel loads were inventoried using Brown’s fuel transects and the Photo Series for Quantifying Forest Residues in the Southwest Region (USDA Forest Service 1997). Initial entry areas averaged up to 10 tons per acre and maintenance burn areas averaged about 2 tons per acre.

Table 2. Dead woody debris by size-class for initial entry and maintenance burn areas in the Twin project area.

Fuel Size Class (diameter)	Initial Entry (tons/acre)	Maintenance Burn (tons/acre)
Less than 3 inches	2.5 - 3.5	1.17
3 to 9 inches	1.5 – 2.5	.73
Greater than 9 inches	4 - 5	0
Total Fuel Load	8 - 10	1.9
Duff & Litter depth	2.5 - 3.5 inches	1.2 inches

Although most of the maintenance burn areas have fuels loads averaging 2 tons/acre, about 3% of the area (~250 acres) has fuel loads up to 15 tons/acre. This occurred because after the "initial entry" burns, pockets of dense small-diameter trees were killed. These dead trees are now small logs, making up much of the higher fuel loads in these areas. The pockets of mortality helped to meet the project objectives by reducing stand densities and creating forest openings. However, maintenance burns are needed to consume these fire killed trees.

Crown Base Height

Crown base height is expressed as the height of the lowest live tree branches from ground level. Mistletoe and high densities of smaller trees in the understory effectively lower crown base heights. Low crown base heights serve as fuel "ladders," increasing the probability of fire getting up into the canopy and initiating a crown fire. Young seedlings and sapling trees easily ignite because their live crowns are close to the forest floor. Low-density seedling trees do not generally contribute to increased fire intensity because they torch independently rather than by groups. Historically, naturally occurring periodic fires consumed ladder fuels and pruned lower branches of trees.

In the Twin project area, tree heights generally range from 20 to 60 feet with crown base heights of 7 to 28 feet, and average 25-35 feet with crown base heights of 6 to 15 feet. There are also are many trees with crown base heights less than six feet. *Target crown base heights for the project are approximately half the total tree height.*

Live Stand Density

Live stand density is an important part of the fuels matrix because live trees actively burn when they grow under dense conditions. Live tree density is measured in terms of number of trees per unit area, and basal area of trees (cross-section) per unit area. Across the Twin project, trees per acre average 450, but they vary by stand. The eastern half of Twin has densities ranging from 80 to 180 trees/acre, and near Bixler Saddle, some Douglas fir stands have tree densities up to 900 trees/acre. Basal area in the eastern portion of Twin averages 80 ft^2/acre, and in areas defined as Mexican spotted owl "protected and restricted habitat," basal area averages about 120 ft^2/acre.

Direct and Indirect Effects

Forest Vegetation Simulation Modeling

The Forest Vegetation Simulator (FVS) is the Forest Service's nationally supported modeling program used to predict forest stand dynamics over time. Although originally developed for modeling growth and yield, it has the capability to model fuel loading by size-class, fire effects, and fire potential using site-specific stand and fuel conditions (Reinhardt and Crookston 2003). FVS outputs describe fire type, torching index, crowning index, as well as flame length over time.

Fire Type is categorized one of three ways for this analysis. "Surface" fire, where only fuels on the ground support the fire; "passive crown" fire, where some tree crowns burn as individual trees or groups of trees torch; and "active crown" fire, where a fire moves through the canopy, burning all crowns, and killing all the trees in the stand. *The target condition is a surface fire.*

Torching Index is the wind speed at 20 feet above the canopy required to cause torching of some trees expressed in miles per hour. For example, a torching index of 35 would indicate that in order for torching to take place on a fire, the wind would have to blow 35 miles per hour or higher. The higher the torching index, the lower the probability of torching fire behavior. *The target condition is greater than 30 miles per hour*.

Crowning Index is wind speed at 20 feet above the canopy required to maintain a crown fire expressed in miles per hour. For example, a crowning index of 35 would indicate that in order for crown fire to continue, the wind would have to blow 35 miles per hour or higher. The higher the crowning index, the lower the probability of a sustained crown fire. *The target condition is greater than 30 miles per hour*.

Flame Length is expressed in feet. *The target condition is a flame of less than four feet*, allowing firefighters to use direct attack tactics.

Simulation Specifications

Using data from a Twin project area stand, FVS estimated potential fire behavior over the next 40 years, with and without treatment. The stand is dominated by ponderosa pine, but contains a mix of oak and juniper.

Figure 3. FVS representation of the initial stand conditions used in the simulation.

The stand has a basal area of 135 ft^2/acre and 1,003 trees/acre. About 75% of the trees are seedlings, 20% of the trees are in the 7 to 9 inch class, 5% are in the 15-17 inch class, and less than 0.5% are over 20 inches. The initial DWD fuel loading was 3 tons per acre, with the following diameter distributions: 0 to 3 inches =1.6 tons/acre, 3 to 9 inches 0.2 tons/acre, and greater than nine inches 1.2 tons/acre. Duff and Litter depth was 2 inches.

Under Alternative 1 - No Action, FVS "grew" the stand for 40 years to predict potential wildfire behavior and fuel loadings. Under the Alternative 2 - Proposed Action, a low intensity prescribed burn was simulated under the conditions to represent fall burning: winds at 9 miles per hour, a temperature of 72 degrees F, and fuel moistures typically occurring in the Fall. A maintenance burn was simulated every 8 years after the initial burn. Potential fire behavior outputs for both alternatives are shown below at 5, 20, and 40-year intervals.

Table 3. Potential behavior and conditions of wildfire for the No Action and Proposed Action alternatives at 5, 20, and 40 years post treatment.

5 Years Post Treatment (2011)

Attribute	Target Condition	No Action Alternative	Proposed Action
Fuel Loading (Tons/Ac)	0-3	16.8	15.3
Fire Type	Surface	***PASSIVE***	Surface
Crown Index (mph)	30+	24.1	29.9
Torching Index (mph)	30+	20.3	55.8
Flame Length (feet)	<4	**34.2**	2.7
Tree Mortality (% BA)	40-60	99	41

20 Years Post Treatment (2026)

Attribute	Target Condition	No Action Alternative	Proposed Action
Fuel Loading (Tons/Ac)	0-3	25.2	12.4
Fire Type	Surface	***PASSIVE***	Surface
Crown Index (mph)	30+	29	42.1
Torching Index (mph)	30+	0	79.2
Flame Length (feet)	<4	**33.8**	2.5
Tree Mortality (% BA)	<20	99	16

40 Years Post Treatment (2046)

Attribute	Target Condition	No Action Alternative	Proposed Action
Fuel Loading (Tons/Ac)	0-3	32.9	12.5
Fire Type	Surface	***PASSIVE***	Surface
Crown Index (mph)	30+	36.4	54.8
Torching Index (mph)	30+	0	88.4
Flame Length (feet)	<4	**23.3**	3.1
Tree Mortality (% BA)	<20	98	15

Alternative 1 – No Action

Under the No Action alternative, the FVS runs show that potential fire behavior increases over time. Fuel loading and stand density continues to increase, and the fire risk potential would remain high. Passive crown fires would be expected during peak fire season, limiting fire crews to indirect firefighting tactics.

The DWD tons/acre increases from about 17 to 33 tons/acre, with reductions in all fuel size-classes. In the event of a wildfire, PASSIVE crown fires would be anticipated for all output years. A passive crown fire type indicates that some tree crowns burn as individual trees or groups of trees torch; however, based on the mortality observed, these passive crown fires killed nearly all the trees in the stand (98%-99% basal area mortality). Torching index drops from about 20 to 0 by year 2026. At the 20 and 40 year intervals torching index is zero, which means no wind is required for trees to torch. Within 5 years, flame lengths exceed those that can be directly suppressed by firefighters or machinery (4 and 8 feet maximums, respectively). Under the No Action Alternative, we would expect to see a reduction in crowning index and an increase in flame length over time, however this was not observed in the output results.

Alternative 2 – Proposed Action

The proposed action results in a decrease in potential fire behavior. DWD fuel load decreases over time and torching and crowning indices increase over time (i.e. it will take more wind to initiate and maintain crown fires).

Fuel Loading: The proposed action shows a reduction in fuel loading from 15.3 to 12.5 tons/acre. This trend would continue with repeated maintenance burning treatments. The burn objectives for the intensive zone of the Wildland-Urban Interface is 0-7 tons per acre of down, dead, woody material. The objective for areas outside the Wildland-Urban Interface is 5-7 tons per acre. Between each cycle of burning, fuel levels build, and soon exceed the desired condition. Following each burn, fuel loads return to acceptable levels and then steadily increase. Implementing maintenance burns at 2 to 10 year intervals would maintain fuel loads at close to target condtions. Although the FVS output shows fuel loads building back to 12 tons/acre relatively quickly, post-burn montioring in the area indicates that predicted fuel accumulations may be overestimated by the model.

In initial entry areas, higher mortality is anticipated in areas with high densities of small diameter trees, as observed in the Stage burn. The Stage Burn was a two-thousand acre prescribed burn within the Twin Project area. Stage was underburned in 1993, with maintenance burns in 1999-2002. The preburn conditions in the Stage project were similar to Twin. Therefore, it is anticipated that the post-burn fuels effects of Stage should approximate the fuels effects of burning in the other unburned areas of Twin (Area B). In the Stage Burn, all DWD classes (especially 0-3”), showed reductions in fuel load; however, there were some initial increases in the larger fuel diameter-classes.

Torching index: The proposed action increases crown base height over time by pruning with fire. This is evident in the observed increase of the torching index from about 56 mph in 2011 to about 88 mph in 2046. Since crown base height is the most influential factor in determining torching index, this is an indication that the proposed action is effectively raising crown base height.

Flame length: There is a slight increase in flame lengths from 2026 to 2046. Although it seems counterintuitive that flame lengths would increase under the proposed action, the 2046 report year

falls immediately before the scheduled maintenance burn. It reflects the fact that down woody debris continually builds and requires regular burning to remove fuel accumulations (Sackett 1980) and maintain flame lengths within target levels.

Tree Mortality: The proposed action decreases tree densities over time. This is shown in the decrease of percent tree mortality (expressed in terms of basal area) from 41% in 2001 to 15% in 2046. Fewer trees will result in decreased fire behavior potential over time.

The simulation shows that thinning the live tree density, reducing fuel loads (DWD) and reducing ladder fuels, reduces the potential wildfire behavior, allowing firefighters to more aggressively fight fires. Additionally, the simulation demonstrates the need for regular maintenance burning. Fuel loads continually build up, increasing fire potential. Regular burning maintains desired conditions by raising crown base heights, reducing surface and ladder fuels, and reducing stand density. This provides for better protection of private property, the Williams municipal watershed, and forest resources over time.

Cumulative Effects

Because hazardous fuel conditions have the potential to pose a threat to private property and forest resources when they are several miles away, the cumulative effects analysis area for fuels extends 5 miles outside the project boundary. The analysis area is approximately 460,000 acres. Fuel loadings in ponderosa pine following a burn return to pre-burn fuel loadings in approximately 10 years. As a result cumulative fuels effects are analyzed from 10 years prior to 10 years after project implementation.

Relevant projects in the Analysis Area in the last 10 Years:

About 4,300 acres had prescribed burning from 1995 to 1999 immediately southwest and southeast of Bill Williams Mountain during the old Twin project. Additionally, about 3,200 acres were prescribed burned from 1999-2001 in the southwest portion of the current Twin area (Dutch Kid and Stage projects). The Williams High Risk project mechanically thinned trees less than 9 inches dbh on about 658 acres scattered within the Twin area and up to two miles outside the Twin project boundary in all directions. There is one active grazing allotment; grazing reduces fine fuels in the area.

Ongoing and Planned Actions In and Adjacent to the Twin Project Area:

The City Project is currently being planned and covers 12,308 acres in the urban interface surrounding Williams, Arizona, just north of the Twin Project. The proposed action for City includes a variety of treatments, including commercial and pre-commercial thinning, pile burning and underburning. To the north and east, the Dogtown project covers almost 7,300 acres near the Woods Subdivision. Implementation of Dogtown should begin in the near future. Like City, Dogtown includes a variety of treatments such as commercial and pre-commercial thinning, pile burning and underburning. Adjacent to Twin to the east and south, “McCracken” has restoration objectives that will include about 12,000 acres of various commercial and non-commercial thinning, pile burning and underburning. The District is scheduled to begin planning on the McCracken Vegetation Project in 2007.

Implementation of the above fuel reduction projects (including Twin), would each likely take about a decade. There would be some staggered short-term localized increases in fuel loading and fire potential, immediately following vegetative treatments, but cumulatively, fire severity

would decrease. In the longer term, they would each contribute to a much lower risk of a stand replacing wildfires. Wildfires may still occur; however, they would likely be low-intensity ground fires, resembling those that occurred prior to Euro-American settlement.

The net effect of the proposed action when combined with the ongoing and planned actions would be a decrease in DWD and stand density and an increase in crown base height. As a result, potential fire behavior would be decreased over time within the cumulative effects analysis area. The Twin project would contribute to the ongoing "landscape-level" treatments that are moving the urban interface in the Williams District toward more desired defensible conditions.

Air Quality

The Twin project lies within the Verde River Airshed. The nearest Class I area is Sycamore Canyon Wilderness, about 10 miles southeast of the project area. Class I areas are subject to the highest restrictions on how much additional pollution, or increment, can be added to the air.

The evaluation criterion of small particulate matter (PM-10 = particulates ten microns or less in diameter) was used to assess the impact of the proposed action on air quality. Particulate matter is a criteria air pollutant, which includes dust, soot, and other tiny bits of solid materials that are released into and move around in the air. Particulates are produced by many sources, including burning of diesel fuel by trucks and buses, incineration of garbage, road construction, mining operations, slash or broadcast burning, and operation of fireplaces and woodstoves. Many epidemiological studies have shown statistically significant association of ambient particulate matter (PM) levels with a variety of human health effects, including mortality, hospital admissions, respiratory symptoms and illness measured in community surveys (Brauer 1999). Nonattainment areas are geographic areas in which the level of a criteria air pollutant is more restrictive than the level allowed by federal standards. Attainment areas are geographic areas in which levels of a criteria air pollutant meet health-based primary standards (national ambient air quality standard). An area can be both attainment and nonattainment at the same time, as it can have acceptable levels of one criteria air pollutant but unacceptable levels of one or more other criteria air pollutants. It has been estimated that 60% of Americans live in nonattainment areas.

The AP-42 Emission Factor is used for analysis. It is a simple model and does not give weight to site-specific conditions that would demonstrate more variability. However, it does demonstrate trends and relative differences between the alternatives. The formula used to calculate emissions is: (Unit Size) X (Fuel Loading) X (ADEQ AP 42 Factor) / (2000 lb./1 Ton) = Tons of PM 10 particulate matter/day. The AP 42 factor is different for pile burns (10) and underburns (60).

Direct and Indirect Effects on Air Resource Values

Alternative 1 – No Action Alternative

Under the No Action Alternative, there would be no burning, therefore PM-10 emissions would be zero. If an uncontrolled wildfire were to occur, the estimated emissions would likely exceed federal and state ambient air quality standards within the Verde Airshed. Below are emissions estimates for a wildfire for one day to a few weeks (or until the area was burned through). This estimate makes the following assumptions: 50% of the crowns would burn in the event of a wildland fire. The weight of the crowns (pine needles and all material smaller than 1" in

diameter) consumed at fuel moisture of 110% is estimated at 6.45 tons/acre. The crown weight (6.5 tons/acre) was added to the dead and down fuel loading (4.4 tons/acre) for the fuel total used to estimate wildfire emissions.

Emission Estimates

Wildfire- (50 acres) (10.9 tons/ac) (60) /2000 = 16.4 tons/day of PM 10
Wildfire- (100 acres) (10.9 tons/ac) (60) /2000 = 32.7 tons/day of PM 10
Wildfire- (1000 acres) (10.9 tons/ac) (60) /2000 = 327.0 tons/day of PM 10
Wildfire- (10000 acres) (10.9 tons/ac) (60) /2000 = 3270.0 tons/day of PM 10

Actual emmisions from a wildfire would likely exceed those shown above because the estimate uses an AP-42 Emission Factor normally used for prescribed burns. In the event of a wildfire, there would likely be greater emissions because wildfires consume fuels not normally consumed on prescribed fires (for e.g., live fuels).

High intensity wildfires often occur under drier conditions which results in a greater consumption of large logs, duff layers, and unprotected snags, which produce additional smoke emissions not accounted for in this analysis. Wildfires often release toxic pollutants because things burn that would not be burned under the proposed action (for e.g., vehicles, furniture, fossil fuels, etc.). The effects from wildfires tend to be more acute for smoke-sensitive individuals because wildfires do not necessarily occur when ventilation is good. Additionally, wildfires burn during all hours of the day, including evenings and mornings, compounding smoke impacts.

Alternative 2 – Proposed Action

The Twin project consists of approximately 14,800 acres of ponderosa pine and Gamble oak that has been proposed for treatment with prescribed fire. Approximately 50% of the assessment area has not experienced fire for several decades and has high fuel loading. The pre-treatment fuel load estimate for this assessment is 4.4 tons with approximately half of the mass being greater than 3 inch diameter material.

Under the Proposed Action Alternative, PM-10 emissions are estimated by activity as follows:

Emission Estimates

Pile Burn: Average estimates of fuel consumption of pile burns is 95% to 100% of the fuels.

(50 acres) (8 tons/ac) (10) /2000 = 2.0 tons/day of PM 10
(100acres) (8 tons/ac) (10) /2000 = 4.0 tons/day of PM 10

Underburn: Average estimates of fuel consumption during underburns is 80% of the down woody fuels. This estimate uses 80% of 4.4 tons/acre, for a fuel consumption estimate of 3.5 tons/acre.

(50 acres) (3.5 tons/ac) (60) = /2000 = 5.3 tons/day of PM 10
(100 acres) (3.5 tons/ac) (60) = /2000 = 10.5 tons/day of PM 10

Maintenance Burn: Average fuel consumption estimates for maintenance burns is 70%. Premaintenance burn fuel loading is estimated at 3.4 tons/acre based on the Dutch Kid and Stage burns. This estimate uses 70% of 3.4 tons/acre, for a fuel consumption estimate of 2.4 tons/acre.

(50 acres) (2.4 tons/ac) (60) = /2000 = 3.6 tons/day of PM 10
(100 acres) (2.4 tons/ac (60) = /2000 = 7.2 tons/day of PM 10

In addition to the material released into the atmosphere (estimated above), ventilation, unit size, wind speed, wind direction, and proximity also influence smoke impacts. Ventilation is the degree to which smoke disperses into the atmosphere. Proximity is the distance from the source of smoke to the impacted area (generally residences). Smoke impacts from prescribed burns are generally reduced by conducting burns on days with good ventilation and when wind speed and direction would reduce smoke impacts. Additionally, prescribed fire operations typically ignite during the best ventilation hours of the day.

The Arizona Department of Environmental Quality (ADEQ) closely monitors, coordinates, and regulates prescribed burning to ensure emissions do not exceed federal and state ambient air quality standards. Pursuant to Arizona Administrative Code Title 18, Chapter 2, Article 15, federal and state land managers must submit an ADEQ Burn Plan, smoke dispersion map, and smoke modeling report for all burn projects that are greater than 250 acres per day, or greater than 50 acres per day if the burn is within 15 miles of a Class I area, an area that is nonattainment for particulate matter (PM) or carbon monoxide, or any other smoke sensitive area. Smoke modeling estimates are based on anticipated fuel consumption, particulate emissions, and dispersion of particulate matter (PM) from the prescribed burn.

Under the Proposed Action Alternative, the timing of emissions would be controlled. Smoke-sensitive residents would be notified prior to burning, allowing them to make arrangements to reduce exposure. Smoke impacts are generally highest on the first and second days of burning. Smoke impacts to local residents would be reduced by mechanically pulling and piling slash away from private residences. Although these measures reduce negative effects, some short term negative effects can occur because large fuels may smolder for several days and smoke may linger, especially in low lying areas.

Production of dust from fuels reduction operations would also occur as a result of the use of vehicles and heavy equipment, particularly on dirt or graveled roads. The effect would be localized (within a few hundred yards of the vehicle or equipment) and short-term (ending immediately after the equipment stops moving, or drifting off as the vehicle moves along the road, and only in dry conditions).

Cumulative Effects

The area used for the air quality cumulative effects analysis is the Verde Airshed, which covers much of the Williams Ranger District of the Kaibab National Forest, part of the Prescott National Forest, the western half of Coconino National Forest, as well as tribal, state, and private lands west of the Kaibab National Forest (see Figure 4). Air resources are somewhat unique in that the cumulative effects of past projects to air quality are not very evident. The timeframe for this analysis is 3 days, because smoke readily disperses, especially when ventilation is good (an implementation specification for the proposed action).

In 1999, over 200,000 acres in Arizona were treated with prescribed fire, producing about 35,000 tons of PM-10 emissions. At certain times of the year, especially in the Fall, consideration of the cumulative impact is critical, as weather and fuel conditions are most conducive to prescribed burning. Within the Verde Airshed a number of federal and state land management agencies are

trying to meet fuels reduction targets including the Prescott, Coconino, and Tonto National Forests; Arizona State Land Dept.; City of Flagstaff; Grand Canyon National Park; Flagstaff Areas National Monuments; and Indian Tribes in the area.

The cumulative impact of smoke from the Twin Burn, when combined with impacts from other prescribed burns, residential wood combustion, traffic exhaust, fugitive road dust, and other sources of smoke and pollution could be substantial. Because of this, fire-use is regulated through a permitting process with the Arizona Department of Environmental Quality (ADEQ), which considers the overall effect and timing of particulate producing activities within each airshed. A 300-acre day of underburning in Twin could emit up to 32 tons/day of PM 10. This would contribute to the existing levels of particulate in the airshed. The cumulative effect of the proposed action when combined with other past, present, and reasonably foreseeable projects would be an increase of PM emissions in the short term that would generally disperse within a few days. By regulating potential emissions sources, ADEQ ensures that the project does not exceed federal and state ambient air quality standards within the Verde Airshed.

Figure 4. Arizona Smoke Management Airshed Map

Overstory Vegetation

Background

In the late 1800's, the eastern portion of the project area was logged extensively prior to regulation by the Forest Service. The railroad had timber rights, and removed most of the larger old yellow pines for the production of ties and other products. Forest Service regulated sales within the analysis area began in the 1920's and continued on into the 1970's. These sales mostly removed the large yellow pines and largest black-bark pines, leaving only a few large trees as a seed source. Later sales removed the older, less vigorous and diseased "high risk" yellow pine and large blackjacks. Small diameter trees (6" to 12"+ diameter) were harvested across much of the analysis area under the Colorado Plateau Pulpwood Contract from 1971 to 1982. There were scattered noncommercial thins in the analysis area from the late 1970's to the early 1980's. The Andrew Timber Sale in 1982 thinned pine down to 12" in diameter in the eastern portion of the analysis area.

The two most recent timber sales in the analysis area were the Pine Springs Sale in the western part of the analysis area and the Cougar II Sale in the eastern portion of the analysis area. The Pine Springs Sale was logged in 1989 and 1990. It included overstory removals, mistletoe sanitation cutting, and commercial thinning of trees down to 12" in diameter. Noncommercial thinning and sanitation cutting of smaller trees followed the sale. The Cougar II Sale was logged in 1988 and 1989. It included commercial thinnings, shelterwood cuts, and sanitation cuts. It was followed by pulpwood thins in 1991 and 1992, and noncommercial thinning and sanitation cutting through the mid-1990's.

Management over the past 100 years has resulted in a decreased number of large mature pines in the project area. However, in the last 15 years, management has focused on retaining large mature pines, and increasing the growth of the medium sized trees to act as future replacements. More recent management has also focused on protecting the large oak, pine, and juniper from fire and competition-induced mortality by thinning the understory around these trees.

Affected Environment

Overstory vegetation in the Twin project area is dominated by ponderosa pine, with Gambel oak found throughout the area. The southern third of the project area is a transitional pinyon pine-juniper woodland. Some stands of mixed conifer containing Douglas-fir and white fir, and aspen occur on northern aspects, drainage bottoms, and on higher elevation slopes. A number of natural meadows are scattered throughout the forest and woodland vegetation types.

The ponderosa pine forests and the pinyon-juniper woodlands have higher tree densities than they did one-hundred and fifty years ago. Several factors led to increased tree densities including heavy grazing in the late1800's and early 1900's, and the subsequent suppression of natural wildfires (Covington and Moore 1994). Tree densities in the project area average 450 per acre with 80% of the forested area having overstory canopy closures greater than 40%. Local stump evidence indicates that presettlement forests were much more open than they are today. Northern Arizona ponderosa pine forests have been shown to have tree densities averaging about 25 trees per acre and canopy closures ranging from 5 to 20% (Covington and Moore 1994, Mast et al. 1999). High tree densities contribute to reduced tree growth and vigor; reduced understory vegetation development and structural diversity; and increased susceptibility to loss from fire, insects, and disease.

The Twin area is dominated by mostly even-aged (60 to 90 years old) ponderosa pine trees, with a few open areas that support the tree regeneration and understory development of grass, forbs and shrubs. Six to seven trees per acre within the analysis area are greater than 18 inches in diameter and one to two trees per acre are greater than 24 inches in diameter. Under current conditions, these larger trees have an increased risk of mortality in the event of a wildfire. Dense smaller trees act as fuel ladders, enabling fire to get up into the crowns. Large trees can become girdled and their fine roots damaged when thick accumulations of litter and duff burn around their base.

Competition for moisture, light, and soil nutrients lead to reduced growth and vigor. Growth rates affect the time it takes for smaller trees to grow into larger trees. Low vigor results in trees being more susceptible to attack by bark beetles and other forest pests and pathogens. Bark beetles have killed many trees in the project area over the past several years. Dense growing conditions and the exclusion of natural fires over the past 100 years have led to increased incidences of mistletoe infection. Thirty-eight percent of the project area has some dwarf mistletoe infection, and 19% of the area has moderate to severe mistletoe infection levels.

Environmental Effects

Alternative 1 - No Action

Under the No Action alternative, current tree densities would be retained, gradually increasing over time. Tree growth rates and vigor in the project area would remain low, decreasing over time. Initially, the number of large trees (greater than 18 inches dbh) would remain the same. However, over the long-term, density related competition, wildfire, and bark beetle attacks would likely result in higher levels of mortality in the large diameter trees.

Following successional pathways and growth trajectories, forest openings and natural meadow areas would gradually be lost as the forest canopy closes and as trees encroach into lightly forested or nonforested areas. Some ponderosa pine dominated stands would be converted to mixed conifer cover-types and some aspen stands would gradually be lost as they are overtopped by more shade tolerant species. Medium-sized trees would continue to compete for limited resources and fewer medium-sized trees would grow into the larger diameter classes.

The combination of the loss of large trees, decreased growth rates, and reduced tree regeneration would result in forests that are more even-aged, less diverse, and less healthy. Stress associated with high tree densities would result in some trees being less resistant to infestation by insects, disease, and other pathogens. The risk of epidemic bark beetle infestation would remain high over time and dwarf mistletoe infection levels would continue to spread and intensify.

Tree density and understory fuel loading would continue to increase over time, increasing the risk of stand replacing crown fire and total loss of vegetation (deforestation). Wildfires not only return areas to early seral stages of succession, but they burn at hotter temperatures, scorching of the upper soil layers, reducing organic matter, increasing erosion, and killing seeds needed for regeneration. Large burned/deforested areas can take hundreds of years to recover.

Alternative 2 - Proposed Action

The proposed action would initially reduce the number of existing ponderosa pine seedlings, saplings, and small poles by up to 90% in the intensive treatment zone and up to 50% in areas outside the intensive treatment zone. Existing small to moderate-sized pine seedling regeneration

areas may be lost from underburning; however enough small vigorous pine would be retained to provide for a sustainable distribution of tree size and age-classes over time. The intensive treatment zone would have fewer small ponderosa pines and would remain more open than areas outside the intensive treatment zone. Reducing the density of smaller trees would decrease inter-tree competition and would result in a more vigorous forest.

During initial treatments, the number of large trees greater than 18 inches in diameter could be reduced by up to 5% from prescribed burn mortality. To reduce the risk of killing large trees during prescribed burns, project implementation and mitigation measures will be used to protect large trees including raking the deep needlecast from around their base prior burning, burning under favorable weather and moisture conditions, and varying ignition patterns. Prescribed burning would also protect large trees by reducing "ladder fuels" (dead and down woody material, smaller trees) and canopy continuity. Prescribed burning thins out many of the understory trees that can serve as vectors for flames to get into the crowns. Openings would be created in the forest canopies that reduce crown continuity, preventing crown fires from spreading over large areas. After treatment, the remaining large trees would be less susceptible to mortality from fire and beetles and have increased growth and vigor, which would result in more large trees over the long-term.

Repeated prescribed burning in the Twin area should reduce overall dwarf mistletoe levels. This is because pines infected with dwarf mistletoe often develop a highly flammable, dense mass of branches (broom) that predisposes them to mortality from fire. Small mistletoe infested trees are especially likely to be killed during prescribed burns. Because fire does not selectively kill mistletoe-infected trees and also because there is mistletoe in some larger, more fire resistant older trees, some larger mistletoe infected trees will survive repeated burns, potentially infecting developing pine trees in the understory.

In the fireline preparation area, there is some risk that bark beetles may be drawn into the activity slash from the tree thinning. After emerging from the activity slash, bark beetles may infest surrounding trees and kill them. This potential problem is of particular concern when the thinning is taking place near private property, especially private property where the trees are dense and already stressed. The implementation plan addresses this concern by avoiding thinning that creates excessive slash in the period between January 1 and July 1. If trees cannot be thinned outside of this time period, other mitigation measures would be considered including removal of activity slash from the site or chipping activity slash.

The proposed action would move the forest towards a more diverse vegetative structure by creating more openings in the forest canopy with prescribed burning. These openings will also promote the development of new tree regeneration in the understory. This new age class of trees will lead to a more sustainable forest over time by providing a greater distribution of tree age classes. By maintaining a better distribution of tree age classes, the proposed action will move the analysis area towards the more sustainable vegetative structural stage distribution specified in the Kaibab National land Management Plan (USDA 2004).

Cumulative Effects on Overstory Vegetation

The time frame selected for the silvicultural resource cumulative effects analysis is from 15 years ago to 10 years from now. The cumulative effects analysis area includes the ponderosa pine forest type found in the southwest area of the District. The approximate boundaries of the analysis area is south of Interstate 40, west of Garland Prairie, north of the Mogollon Rim and

east of the edge of the predominantly ponderosa pine type on the western side of the Ranger District. The cumulative effects analysis area is about 143,000 acres in size.

Relevant past, ongoing, and reasonably foreseeable projects include the following vegetative treatment, grassland improvement, and aspen restoration projects: Beacon, Elk-Lee, Round-Oak-Tule, Dogtown, Frenchy, Reneke, Cougar, City, Pine Springs, Sycamore, Pine-Aire, Clover High, Williams High Risk, McCracken, Coleman Lake Aspen Restoration, Aspen Hill Aspen Restoration, Big Springs Aspen Restoration, and Little Pine Flat Aspen Restoration projects.

In the past 15 years, the analysis area has had some sort of vegetative treatment on approximately 11,700 acres. Vegetative treatments are defined as silvicultural treatments that involve felling trees. These treatments included low thinnings, sanitation cutting, group selection cuts, and individual tree shelterwood cuts. Vegetative treatments included commercial logging treatments, noncommercial thinning/sanitation treatments, and a combination of both. Vegetative treatments were usually followed with activity slash treatments including lopping, piling and burning, and/or prescribed underburning. In the next 10 years, approximately 22,800 acres of vegetative treatments are planned for the cumulative effects analysis area. For the 25-year period, beginning 15 years ago and ending 10 years from now, a total of 34,500 acres of vegetative treatments have either been done or are planned to be accomplished. This is approximately 24% of the cumulative effects analysis area.

Over the past 15 years, 23,900 acres of the cumulative effects analysis area has been underburned. Including the proposed action, 47,200 acres of underburning is planned in the next 10 years within the analysis area. Over the 25-year cumulative effects analysis period, approximately 71,100 acres have been or are planned to be underburned. This is approximately 50% of the cumulative effects analysis area.

The effect of these past, current, and foreseeable actions is a landscape with decreased tree densities, more forest openings, reduced dwarf mistletoe levels, and a more diverse vegetative structure. The cumulative effect of the proposed action when combined with these other actions is an augmentation of these positive effects, resulting in a healthier forest that is less susceptible to loss from insect outbreaks or stand replacing wildfire.

Wildlife

Affected Environment

The northern portion of the project area is a ponderosa pine forest with Gambel oak found throughout the area. The southern third of the Twin project is a transitional pinyon pine-juniper woodland. Some Douglas fir, white fir, southwestern white pine, and aspen occur on the northern aspects, drainage bottoms, and higher elevation slopes. The project area provides habitat for a variety of wildlife species, including the federally threatened Mexican spotted owl (MSO), sensitive species such as the northern goshawk and the American peregrine falcon, birds of conservation concern, and game species such as turkey, pronghorn antelope, mule deer, and Rocky Mountain elk.

There are several stock tanks within the project area; they include J.C., Elk, Hells, Station, Borrow, Bixler, and CB tanks. These tanks may provide habitat for waterfowl and other species

during the spring and summer months. If water persists during the nesting season, vegetation around these tanks may be adequate to provide habitat for waterfowl and other species. There are also several ephemeral drainages within the project area with the principal one being Hells Canyon.

Species excluded from detailed analysis and rationale for why these species would not be significantly affected by either alternative is provided in Appendix 1.

Threatened and Endangered Species (T&E)

Bald eagles winter in northern Arizona, occupying roosts or perches (large, open-branched trees or snags) near relatively large open waters or meadows. Bald eagles have been seen along Forest Service Road 108 (in the project area), during the annual bald eagle survey conducted during the first week of January. In the winter, bald eagles forage primarily along rivers and streams and at lakes for waterfowl and fish. Wintering bald eagles opportunistically feed on animal carcasses throughout the forest. Several of the stock tanks listed above may provide foraging areas for the wintering bald eagle.

Mexican spotted owl (MSO) habitat occurs in the project area. There are 220 acres of protected, 4,536 acres of restricted, and 4,413 acres of critical habitat. Of the protected habitat, 175 acres are in the Bill Williams protected activity center (PAC). The area has been surveyed (2003 and 2004) using the US Fish and Wildlife Service Mexican spotted owl survey protocols (USDI 2003) and no owls were detected.

In addition to being federally listed as threatened, the MSO was selected as a forest management indicator species (MIS) to represent late-seral mixed conifer and spruce fir forests. Approximately 27 acres of late-seral mixed conifer occur within the project area, mostly in drainages on the slopes of Bill Williams Mountain and in the PAC. There is no spruce-fir habitat within the project area, so this habitat type will not be addressed further. Condition of the late-seral mixed conifer habitat for the owl within the project area is fair. The late-seral mixed conifer has a high degree of canopy closure that supports the cooler microclimates required by the birds. Late seral mixed conifer also contains an abundance of snags and logs that are important for prey habitat. Habitat quality is diminished by a paucity of large trees important for nesting and roosting.

At the Forest level, there are approximately 1,550 acres of late-seral mixed conifer habitat. The Forest-level habitat trend of late-seral mixed conifer habitat is decreasing, primarily due to loss from stand-replacing wildfires. Forest-level population trends of the MSO appear to be decreasing, based on limited incidental monitoring of PACs on the Forest.

Sensitive Species

Navajo Mexican voles occur in dry grassy areas, usually adjacent to ponderosa pine, but also adjacent to juniper, sagebrush, and spruce-fir. Potential habitat for this species is scattered throughout the project area where dense grassy areas occur near ponderosa pine.

Northern goshawks were selected as an MIS to represent late-seral ponderosa pine habitat on the Forest, in addition to being identified as a Forest Service Sensitive Species for the Region. Approximately 1,630 acres of late-seral ponderosa pine vegetation type occurs within the project area. Quality of late-seral ponderosa pine habitat within the project area is fair for the goshawk.

Although snag and log numbers are within target ranges, there is a scarcity of large trees important for goshawk nesting. Also, the large number of small and mid-size trees decrease habitat heterogeneity, which is important for goshawk prey species diversity and abundance.

There has been controversy on whether northern goshawks are habitat generalists that use a variety of forest types and structural stages, including forest edges and openings, or whether goshawks are habitat specialists of old-growth forests as contended in Center for Biological Diversity and Sierra Club v. USFS, et al., 349 F, 3d 1157 (9th Cir. 2003), based on over nine papers published on the subject in the late 1990s. Reynolds (2004) reviewed these papers and other existing information on habitat use by the northern goshawk. His synthesis, and our conclusions for goshawk management are summarized below.

Northern goshawks are morphologically and behaviorally adapted to hunt for birds and mammals in forests and woodlands. They breed in most forest and woodland types that occur in their geographic range. Though they are not limited to old growth forests, goshawks spend much of their time in forested areas with large, tall trees, likely owing to the availability of trees that will support nests, the facilitation of hunting below the lifted tree crowns, and the high availability of goshawk prey in these areas. Kill sites, where prey remains have been plucked by goshawks, tend to occur in areas with high canopy closure, high tree densities, and many larger trees greater than 16 inches diameter at breast height (Beier and Drennan 1997). Note that these kill sites have been inferred as foraging habitat, perhaps erroneously as these sites may not reflect attempted-escape movement by prey prior to capture, goshawk movement to these sites after prey capture, or a goshawk's use of multiple kill sites.

Goshawks use a diverse array of vegetation types, including mixed conifer, ponderosa pine, pine-oak, and aspen. Goshawks also use a variety of seral and structural stages, including forest edges and openings. In winter, and when farther from their nests, goshawks forage in forests with a variety of vegetation and structural conditions. Use of other vegetation types by goshawks is also related to the habitats of the local prey species (i.e., when key prey in an area use forests, forest edges, and openings, so do the goshawks).

Management recommendations from Reynolds et al. (1992) were incorporated into the Kaibab National Forest Land Management Plan, as amended in June 1996, to promote conservation of habitat for the goshawk and its major prey species. Management for goshawk habitat in the Plan includes guidelines to protect nest areas (active, historic, and replacement) and post-fledgling family areas, as well as key components of goshawk habitat (e.g., large trees, canopy cover, and old-growth forest).

Major prey species identified in goshawk research on the North Kaibab Ranger District of the Kaibab National Forest include golden-mantled ground squirrels, cottontails, Steller's jays, and northern flickers (Mannan and Boal 1993). Tassel-eared squirrels are added to this list for major prey species within the project area. These five primary prey species occur in a variety of environments, including older and mid-successional forest, along forest edges, and in small openings. Therefore, management for goshawk prey habitat within the project area appropriately includes guidelines to promote various structural stages and small openings, as well as key features of prey habitat (e.g., snags, downed logs, and woody debris).

The project area contains six delineated northern goshawk post-fledgling family areas (PFAs) and nest areas, as well as foraging habitat. Informal monitoring has been done of the nest areas within the project area (PR # 87). All of these areas have had successful goshawk reproduction

in the past. None of the historic nest sites have been recently used, though goshawks may still be in the area.

At the Forest level, there are approximately 100,700 acres classified as late-seral ponderosa pine. The Forest-level trend of late-seral ponderosa pine appears to be slightly positive, due to the shift in Forest objectives and harvest techniques since 1992, which focuses on removal of smaller trees and promotes long-term growth of larger trees. The Forest-level goshawk population trend appears stable, and may be increasing on the North Kaibab Ranger District.

Management Indicator Species (MIS)

MIS within the Forest are designated within each Ecosystem Management Area (EMA) as identified in the Kaibab National Forest Plan (USDA Forest Service 2004). The project area is situated within EMA 2 and EMA 22. MIS within EMA 2 that have the potential to occur within the project area and be affected by the proposed action include Rocky Mountain elk, mule deer, turkey, tassel-eared (Abert) squirrel, hairy woodpecker, red-naped sapsucker, and pygmy nuthatch. The MSO and Northern goshawk are also identified as MIS and are addressed in their T&E and Sensitive sections respectively. There is no riparian habitat for Lucy's warbler, yellow-breasted chat, cinnamon teal, or aquatic macroinvertebrates within the project area, and would therefore not be affected by the proposed action. There are no MIS designated for EMA 22 which is an undeveloped recreation area. Additional information on the status of MIS and their associated habitat at the Forest-level can be found in Management Indicator Species for the Kaibab National Forest, Version 1.2 (USDA 2003).

Rocky Mountain elk were selected as an MIS, to indicate habitat quality for big game species using the early-seral stage of ponderosa pine and mixed conifer habitats within the forest. Although these animals prefer savannah and grassland conditions, browse and forage habitat as well as thermal and hiding cover of the early-seral stage are important habitat attributes for elk. Elk may use the project area for summer range and in movements between winter range (west and south of Williams) and summer range (near Rogers Lake just west of Flagstaff).

Rocky Mountain elk have spread across the District since their introduction to northern Arizona in 1913, after the extirpation of Merriam's elk from Arizona in the late 1890s (Lee 1986). The Arizona Game and Fish Department (AGFD) controls elk numbers through hunting permits. Under the Arizona Wildlife and Fisheries Comprehensive Plan (USDA & AGFD 1990), a goal was set to manage herd numbers between 3,000 and 4,500 elk in Game Management Units (GMU) 7, 8, and 9 (which include the Tusayan and Williams Ranger Districts). Population estimates in 2001 suggest approximately 7,100 elk occur within these three units (note that elk in GMU 8 interact with those in GMU 6 and Camp Navajo, and are treated as a single herd). Population trends for elk within the project area have been decreasing since the mid 1990's as the result of regulated hunting.

The project area contains approximately 2,800 acres of early seral ponderosa pine and 48 acres of early-seral mixed conifer habitat. Early-seral ponderosa pine and mixed conifer habitat quality within the project area is good, owing to the abundance of small trees, which provide thermal and hiding cover.

At the Forest level, the early-seral ponderosa pine and mixed conifer vegetation types total approximately 15,400 and 1,050, respectively. Early-seral ponderosa pine and mixed conifer habitat trends have been stable, owing to a balanced combination of encroachment by small

trees, countered by vegetative treatments and prescribed and wildland fires that have removed small trees. The Forest-level population trend for elk was increasing into the mid-1990s, but has been purposefully decreased since through increases in hunt permits issued by AGFD.

Mule deer were selected as an MIS to maintain the desired characteristics found in the early-seral stage of the aspen and pinyon-juniper habitats. There are approximately 3,050 acres of pinyon-juniper habitat within the project area, of which about 800 acres are in early-seral condition. There are approximately 2 acres of early seral-aspen within the project area. The early-seral aspen habitat within the project area is in poor condition, owing to conifer overshadowing, drought, and decadence from the absence of fire. The early-seral pinyon-juniper habitat quality within the project area is mixed. Good early-seral pinyon-juniper habitat is associated with a healthy presence of browse plants such as cliffrose and mountain mahogany that are important to the mule deer.

Mule deer may be found within the project area from late spring through late fall. Annual population status of this species is monitored by AGFD. District trends for this species have been decreasing.

At the Forest level, there are about 2,800 acres of early-seral aspen and 4,300 acres of early-seral pinyon-juniper. Early-seral aspen habitat trends are declining across the Forest, owing to overtopping by conifers, limited regeneration from fire suppression, and heavy ungulate browsing. In general, early-seral pinyon-juniper habitat trends have been increasing at the Forest-level because of the expansion of pinyon-juniper woodlands from past grazing and fire suppression. However, these increases have been lessened by vegetative treatments, wildfires, and drought. Forest population trends of the mule deer have decreased on the Williams and Tusayan Ranger Districts, and increased on the North Kaibab Ranger District.

Pronghorn antelope were selected as an MIS to represent early and late-seral grasslands within the forest. There are approximately 23 acres of grassland vegetation identified within the project area. Pronghorn antelope mostly use the project area as a migration route between summer and winter ranges. Pronghorn antelope prefer open grassy areas and savannahs with intermittent trees.

Pronghorn in GMU 6B (just east of GMU 8) are considered a different band within the same herd as GMU 8. As a result, the bands in GMU 8 and 6B are managed as a single herd. The AGFD annually monitors the population status of these bands. Population trends within GMU 8 appear to be stable with annual variations, while those in GMU 6B have been slightly decreasing since the mid 1990s.

At the Forest level, there are approximately 249,293 acres of grassland. Forest-wide, there appears to be a generalized stable to upward trend in grassland habitat. Forest-level pronghorn population trends were reported to be increasing in the MIS Report for the Kaibab NF (USDA 2003), though recent data from AGFD suggest the trend is stable.

Tassel-eared squirrels were selected as an MIS to represent early-seral ponderosa pine within the Forest, though medium-sized trees and the presence of interlocking canopies in ponderosa pine are more important attributes for the squirrel (Dodd 2003, Brown 1995). In fact, a negative relationship between early-seral ponderosa pine, or small, sapling-sized trees, and squirrel recruitment and survival has been documented (Dodd 2003). As a result, this analysis will focus on mid to late-seral ponderosa pine and canopy interconnectedness. There are approximately

8,000 acres of mid to late-seral ponderosa pine forest within the project area. Mid to late-seral ponderosa pine habitat quality within the project area is good for the tassel-eared squirrel, owing to the high canopy closure and abundance of interlocking branches, which promote squirrel travel between trees and the development of mycorrhizal fungi, an important food item for the squirrel. Tassel-eared squirrels, their sign, and nests, have been frequently observed within the project area.

At the Forest level, mid to late-seral ponderosa pine totals approximately 328,000 acres. Mid-seral ponderosa pine habitat and canopy interconnectedness trends have been declining, owing to vegetative treatments that focused on removal of medium, pole-sized trees, and associated reductions in canopy closure that reduce stand-replacing fire risk. Late-seral ponderosa pine habitat trends have been slightly positive, due to the shift in Forest objectives and harvest techniques since 1992, which focus on removing smaller trees, promoting long-term growth of larger trees. The Forest population trend for tassel-eared squirrels appears to be declining. Tassel-eared squirrel monitoring is planned across the Forest for summer, 2005.

Turkeys were selected as an MIS to represent species using the late-seral ponderosa pine habitat within the Forest, particularly for roosting and as a seed source for foraging. Approximately 1,630 acres of late-seral ponderosa pine vegetation occurs within the project area. Turkeys use late-seral ponderosa pine habitat primarily for roosting, but also as a seed source for foraging. Roost trees average 16 inches in diameter, occur in groups of 5 to13 trees, are typically multi-storied, and consist of dominant trees with layered, open horizontal branches (Hoffman et al. 1993). Based on past surveys for previous projects, roost sites are found predominantly along drainages or on slopes within the project area. Turkeys have been observed and documented throughout the project area (PR # 87). They use edge habitat between openings and forest cover stands for foraging. Insects, oak mast, and seed heads from grasses and forbs are important food items. Waters, and vegetative cover around waters, are also important. Nests are consistently found on slopes greater than 30% (Hoffman et al. 1993), and may occur within the project area on the slopes of Bill Williams Mountain. Turkey populations within GMU 8 appear to be increasing.

At the Forest level, there are approximately 100,700 acres classified as late-seral ponderosa pine. The Forest-level trend of late-seral ponderosa pine appears to be slightly positive, due to the shift in Forest objectives and harvest techniques since 1992, which focuses on the removal of smaller trees and promotes long-term growth of larger trees. The Forest-level turkey population trend appears to be increasing.

Hairy woodpeckers were selected as an MIS to represent the snag component of the ponderosa pine, mixed conifer, and spruce-fir habitats within the Forest. Hairy woodpeckers are primary excavators and use snags that average 17 inches in diameter for nesting and foraging. Based on stand exam data, snags average 0.22 per acre across the project area (defined as $\geq$18 inches in diameter and $\geq$30 feet in height for coniferous species). This estimate is based on data collected prior to the recent bark beetle attacks that killed many trees, creating more snags. The Forest Plan recommends managing for two snags per acre within ponderosa pine and three snags per acre within mixed conifer areas for goshawk prey, of which the hairy woodpecker is included. Within the project area, the quality of snag habitat for the hairy woodpecker is considered poor, owing to lower than recommended snag densities.

Snag densities average 1.4 per acre across 343,400 acres of ponderosa pine and 21,900 acres of mixed conifer on the Forest. The Forest trend in snag densities in ponderosa pine and mixed

conifer has likely increased, owing to tree mortality from fire, drought, insects, and disease. Hairy woodpecker populations on the Forest are estimated to be stable to increasing.

Red-naped sapsuckers were selected as an MIS to represent late-seral aspen and snags in aspen. Within the project area, there is one stand containing about 10 acres of late-seral aspen habitat. The density of snags within the site is approximately 12 snags per acre (defined as ≥10 inches in diameter for aspen). The stand is in poor condition due to overshadowing by conifers, decadence from the absence of fire, and drought.

There are 280 acres of late-seral aspen on the Forest. Aspen snag densities average 4.2 per acre in aspen stands across the Forest. Forest trends in late-seral aspen habitat are decreasing because conifers are slowly shading out aspen. Forest trends in snag densities in aspen are decreasing, owing to increased aspen mortality from shading, and toppling of snags from rot and disease. The red-naped sapsucker population trend has been stable to decreasing on the Forest.

Pygmy Nuthatches were selected as an MIS to represent species using the late-seral stage ponderosa pine habitat within the Forest. They are primary cavity excavators, using wood that is dead and well-rotted. Because they use large tree cavities for colonial roosts, they need large snags or live trees with dead, decaying parts. Approximately 1,630 acres of late-seral ponderosa pine vegetation occurs within the project area. Pygmy nuthatches are frequently observed in the project area.

At the Forest level, there are approximately 100,700 acres classified as late-seral ponderosa pine. The Forest-level trend of late-seral ponderosa pine appears to be slightly positive, due to the shift in Forest objectives and harvest techniques since 1992, which focuses on the removal of smaller trees and promotes long-term growth of larger trees. The population trend for pygmy nuthatches on the Forest is stable.

Migratory Birds of Concern

Habitats for migratory birds of concern that may occur within the project area include late-seral ponderosa pine and mixed conifer (flammulated owls), mid to late-seral ponderosa pine with dense canopy closure (cordilleran flycatchers, Williamson's sapsuckers), open ponderosa pine forest and pine savannah (Grace's warblers, black-throated gray warblers, olive warblers, and red-faced warblers), open ponderosa pine forest in burned areas (Lewis' woodpeckers), forest openings and edges with numerous dead trees, especially near water (purple martins), forest openings and edges in ponderosa pine and mixed conifer (buff-breasted and olive-sided flycatchers), scrubby pine and pine-oak woodlands (greater pewees, pinyon jays, Virginia's warblers), and grasslands (burrowing owls, chestnut-collared longspurs, ferruginous hawks, golden eagles, northern harriers, prairie falcons, and Swainson's hawks).

Species of Local Concern - Various Bats

Allen's lappet-browed bat and Townsend's big-eared bat may roost, breed, and/or forage in the project area. Maternity roosts of the Allen's lappet-browed bat have been found in exfoliating ponderosa pine snags on the Coconino National Forest (Rabe et al. 1998) and it is likely that this species could also breed and roost within the project area. The Townsend's big-eared bat occurs in coniferous forests and uses tree cavities for night roosts. Both bats are insectivorous.

Environmental Effects

Alternative 1 - No Action

The wildfire potential within the Twin project area is high (Chapter 1 - Purpose and Need). If a crown fire occurred under current conditions, it would influence wildlife species and their habitats within the project area. The following analysis evaluates the effects associated with the No-Action Alternative, and the potential effects of a wildfire burning under current fuel conditions.

Federally Listed Species

Bald eagles: No disturbance effects would occur if no fuels reduction treatments were conducted in the project area. This would not affect the bald eagle wintering population trends because of the limited potential extent of these impacts and the opportunistic foraging nature of the bald eagle. In the event of a high intensity stand replacing wildfire, there would be increased sedimentation to tanks, negatively affecting eagle prey. Large trees would die, creating snags that could provide increased roosting and perching sites.

Mexican spotted owls: Alternative 1 would result in long-term increases in late-seral mixed conifer habitat within the project area as the abundance of large trees increase. Quality of this habitat for the MSO would also increase, owing to further increases over time in abundance, vigor, and longevity of large trees. There would be slight increases in canopy closure, large logs and snags.

Other key effects to the MSO and its habitat from Alternative 1 include the following: a) no reduced risk of stand-replacing fire and associated MSO habitat destruction within the project area, as well as the contiguous areas containing the remainder of the Bill Williams PAC and other MSO habitat; b) continued decreases over time in the abundance, vigor, and longevity of large oak trees in MSO pine-oak habitat, that are important for nesting and roosting of this species in this habitat; and c) continued decreases over time in the abundance and vigor of grasses, forbs, and shrubs used by MSO prey species.

Analysis of effects to MIS indicator habitat and population trends: As there are only 27 acres of late-seral mixed conifer habitat in the project area compared with 1,550 acres of late-seral mixed conifer on the Forest (less than two percent). Past MSO surveys have been negative in the project area and all MSO habitats within ½ mile of the project area. There would be no effect to Forest MSO populations, little effect to Forest MSO habitat, and no effect to the Forest MSO population and habitat trends. In the event of a high intensity stand replacing wildfire the mixed conifer component would be lost and potential nesting and foraging habitat would be unavailable for the species.

Sensitive Species

Navajo Mountain Mexican voles: Ponderosa pine-savannah preferred by this species would not be restored or incur a reduced risk of high intensity wildfire. This would have no effect to the species habitat and population trends because the species is not known to occur within the project area and because of the small areas of savannah encroachment within the project area relative to the much larger range of this species. In the event of a stand replacing wildfire, habitat for this species could be increased as forested areas were replaced by grasslands.

Northern goshawks: Alternative 1 would result in long-term decreases in late-seral ponderosa pine habitat within the project area as the abundance, vigor, and longevity of large trees decrease. Quality of this habitat for the goshawk would incur negative effects from continued decreases in abundance, vigor, and longevity of large trees over time as well as continued decreases in habitat heterogeneity. There would be no loss of larger logs or snags.

Other key effects to the goshawk and its habitat from Alternative 1 include the following: a) no reduction in risk of stand-replacing fire and associated goshawk habitat destruction within and adjacent to the project area, and b) continued decreases in abundance and vigor of grasses, forbs, and shrubs used by goshawk prey species.

These negative effects to habitat features would be subtle changes from the current condition over a long time, and would therefore not affect the foraging or reproductive success of goshawk within the project area.

As there are 1,630 acres of late-seral ponderosa pine habitat in the project area compared with 100,700 acres of late-seral ponderosa pine habitat on the Forest (approximately 1.6 percent), there would be little effect to Forest goshawk populations and habitat, and no effects on the Forest goshawk population and habitat trends. In the event of a stand-replacing wildfire, there would be a loss of nesting and foraging habitat for the goshawk.

Management Indicator Species

Rocky Mountain elk: Alternative 1 would result in continued slight increases in quantity of early-seral ponderosa pine and mixed conifer habitat as tree encroachment continues. Quality of habitat for elk would continue to increase slightly over time as calving cover becomes denser.

Other key effects to the elk and its habitat from Alternative 1 include the following: a) no reduction in risk of high intensity, stand-replacing wildfire and associated loss of grassland vegetation used as elk forage within and adjacent to the project area; and b) continued slight decreases, as a result of continued tree encroachment, in abundance and vigor of grasses, forbs, and shrubs that serve as elk forage and browse throughout the project area. Effects from Alternative 1 on the elk are not likely to be observed at the population level because a) elk populations are managed through Arizona Game and Fish Department hunting permits, b) there are only small areas of grassland openings in the project area relative to such areas available to the elk population, and c) effects from continued tree encroachment would be both positive and negative to the elk and would be subtle and occur over time.

Analysis of effects to MIS indicator habitat and population trends: As there are only 2,800 and 48 acres of early-seral ponderosa pine and early-seral mixed conifer habitat, respectively, in the project area compared with 15,400 and 1,050 acres of such habitat on the Forest (approximately 16% and 4% respectively), there would be little effect to Forest elk populations and habitat, and no effects on the Forest elk population and habitat trends. In the event of a high intensity stand-replacing wildfire, early seral ponderosa pine and mixed conifer would be lost. However, over the long-term regeneration would likely result in their replacement.

Mule deer: Alternative 1 would result in continued slight decreases in quantity and quality of early-seral aspen habitat within the project area from conifer encroachment. Alternative 1 would result in continued slight increases in quantity of early-seral pinyon-juniper habitat with continued encroachment. Quality of early-seral pinyon-juniper habitat may be increased slightly

from continued encroachment, but also would be decreased slightly for mule deer, from continued slight decreases in vigor and abundance of important browse plants in pinyon-juniper habitat. Other key effects to the mule deer and its habitat from Alternative 1 include the following: a) no reduction in risk of stand replacing wildfire and associated loss of mule deer habitat within and adjacent to the project area; and b) continued slight decreases in abundance and vigor of shrubs that serve as mule deer browse throughout the project area.

Overall slight negative effects of Alternative 1 would not be observed at the population level because of the slight magnitude of these effects as well as the following: a) mule deer populations are managed through Arizona Game and Fish Department hunting permits, b) there is a small area of early-seral aspen and early-seral pinyon-juniper in the project area relative to such areas available to the mule deer population, and c) mule deer are habitat generalists, using a variety of habitats in addition to early-seral aspen and pinyon-juniper.

Analysis of effects to MIS indicator habitat and population trends: There are about two acres of early-seral aspen and 800 acres of early-seral pinyon-juniper habitat, in the project area, compared with approximately 2,800 and 4,300 acres of early aspen and early pinyon-juniper , habitat on the Forest (less than 1% and 18% respectively). Because of the relatively small area, there would be little effect to Forest mule deer populations and habitat, and no effects on the Forest mule deer population and habitat trends. In the event of a stand replacing wildfire, early seral aspen and pinyon-juniper would be lost. However, over the long-term, regeneration would likely result in their replacement.

Pronghorn antelope: Under Alternative 1, habitat quality for the pronghorn would continue to decrease as continued tree encroachment reduces cover and vigor of grasses and forbs and predator-sighting distances over time. In addition, Alternative 1 would result in no reduction in risk of high intensity wildfire and associated loss of grassland vegetation and soils within and adjacent to the project area. These influences would have negligible effects on the pronghorn within the project area because a) there is only 23 acres of grassland habitat within the project area, b) tree encroachment would involve subtle changes from the current condition over the long term, and c) pronghorn use of these areas is primarily for fall and spring migration and not for breeding or wintering range.

Analysis of effects to MIS indicator habitat and population trends: As there are only 23 acres of grassland habitat in the project area compared with 249,293 acres on the Forest, there would be little effect to Forest pronghorn populations and habitat, and no effects to the Forest pronghorn population and habitat trends.

Tassel-eared squirrel: Alternative 1 would result in no change in mid to late-seral ponderosa pine. There would be no change in quality of this habitat for the tassel-eared squirrel or canopy interconnectedness. Alternative 1 would not reduce the risk of stand-replacing fire and associated squirrel habitat destruction within or adjacent to the project area. Alternative 1 would not influence squirrel foraging or reproductive success within the project area. In the event of a stand-replacing wildfire, loss of mid to late-seral ponderosa pine would reduce nesting and foraging habitat for the squirrel.

Analysis of effects to MIS indicator habitat and population trends: As there are only 8,000 acres of mid to late-seral ponderosa pine in the project area compared with 328,000 acres of such habitat on the Forest (about 3%), there would be little effect to Forest tassel-eared squirrel

populations and habitat, and no effects to the Forest tassel-eared squirrel population and habitat trends.

Turkey: Alternative 1 would result in long-term decreases in late-seral ponderosa pine habitat within the project area as the abundance, vigor, and longevity of large trees decrease. The quality of this habitat for the turkey would incur negative effects from continued decreases in a) abundance, vigor, and longevity of large trees over time, b) abundance and vigor of grasses, forbs, and shrubs used by turkeys and their insect prey, and c) habitat heterogeneity. There would be no loss of logs and other down woody debris used as turkey cover. Alternative 1 - No Action, would not reduce the risk of stand-replacing fire and associated destruction of turkey habitat within or adjacent to the project area. These effects would not affect foraging or reproductive success of turkeys within the project area because negative effects identified to habitat features involve subtle changes from the current condition over the long-term.

Analysis of effects to MIS indicator habitat and population trends: As there are only 1,627 acres of late-seral ponderosa pine habitat in the project area compared with 100,735 acres of late-seral ponderosa pine habitat on the Forest (~2%), there would be little effect to Forest turkey populations and habitat, and no effects on the Forest turkey population and habitat trends. In the event of a high intensity stand-replacing wildfire, there would be losses of foraging, nesting, and roosting habitat for the turkey.

Hairy woodpecker: Alternative 1 would result in continued increases in small-diameter snags within ponderosa pine and mixed conifer in the project area from bark beetle kill and other tree density-dependent mortality factors, such as drought and fire. Because mostly small-diameter snags would be recruited, this would have little effect on quantity or quality of snag habitat for the hairy woodpecker. Alternative 1 would result in no reduction in risk of stand-replacing fire and associated destruction of hairy woodpecker habitat within or adjacent to the project area. There would be no effects to hairy woodpecker foraging or reproductive success.

Analysis of effects to MIS indicator habitat and population trends: As there are 10,800 and 183 acres of ponderosa pine and mixed conifer habitat, respectively, in the project area compared with 343,400 and 21,900 acres of such habitat on the Forest (~ 3% and less than 1% respectively). There would be little effect to Forest hairy woodpecker populations and habitat, and no effects on the Forest hairy woodpecker population and habitat trends. In the event of a high intensity stand-replacing wildfire, many trees would likely be killed, thereby increasing nesting and foraging habitat for the hairy woodpecker.

Red-naped sapsucker: Alternative 1 would result in continued slight decreases in quantity and quality of late-seral aspen habitat within the project area from conifer encroachment. Snags in aspen stands would not be affected. Alternative 1 would result in no reduction in risk of stand-replacing wildfire within the project area, which would result in both positive and negative effects to red-naped sapsucker habitat. A stand-replacing wildfire would decrease the availability of aspen snags important for nesting, but over time, would improve aspen habitat quantity and quality. A stand-replacing wildfire also would reduce availability of large conifer sap trees important for foraging by the species. The overall slight negative effects of Alternative 1 on aspen habitat could negatively affect foraging and reproductive success for the red-naped sapsucker within the project area. These effects would be minimal, owing to the small area of aspen within the project area and that most effects would be subtle changes from the current condition over time.

Analysis of effects to MIS indicator habitat and population trends: As there are only 10 acres of late-seral aspen habitat in the project area compared with 280 acres on the Forest (approximately 4%), there would be little effect to Forest red-naped sapsucker populations and habitat, and no effects on the Forest red-naped sapsucker population and habitat trends. In the event of a high intensity stand-replacing wildfire, late seral aspen would be lost, but over the longer term aspen stands would likely be resprout, eventually growing into larger, older trees.

Pygmy Nuthatch: Alternative 1 would result in long-term decreases in late-seral ponderosa pine habitat within the project area as the abundance, vigor, and longevity of large trees decreases. Quality of habitat for the pygmy nuthatch would incur negative effects from continued decreases in abundance, vigor, and longevity of large trees and recruitment of large snags over time. Alternative 1 would also result in no reduction in risk of stand-replacing fire and associated pygmy nuthatch habitat destruction within and adjacent to the project area. These effects would not affect foraging or reproductive success of pygmy nuthatch within the project area because negative effects would be subtle changes from the current condition over the long-term.

Analysis of effects to MIS indicator habitat and population trends: As there are only 1,630 acres of late-seral ponderosa pine habitat in the project area compared with 100,700 acres of late-seral ponderosa pine habitat on the Forest (approximately 2 percent), there would be little effect to Forest pygmy nuthatch populations and habitat, and no effects on the Forest pygmy nuthatch population and habitat trends. In the event of a high intensity stand-replacing wildfire, there would be slight decreases in late seral ponderosa pine which would negatively affect nesting and foraging habitat in the short-term, which would be offset by the long term availability of snags created by the fire.

Migratory Birds of Concern

The risk of habitat loss from high intensity wildfire would not be reduced.

Alternative 1 would result in continued slight decreases in the presence of openings and edge habitat, as well as habitat heterogeneity, preferred by the black-throated gray warbler, Grace's warbler, Virginia's warbler, olive warbler, red-faced warbler, Lewis' woodpecker, buff-breasted flycatcher, olive-sided flycatcher, greater pewee, pinyon jay, and purple martin. There would be no loss of the large snags important to the Lewis' woodpecker, olive-sided flycatcher, and purple martin. The slight negative effects would not affect reproductive or foraging success for any of these species, or their habitat and population trends, because of the small amount of habitat within the project area relative to the much larger ranges of these species and because the negative effects would be subtle changes from the current condition over the long-term.

Alternative 1 would result in no change to canopy cover or larger snag densities, but would result in continued slight increases in tree densities that are preferred by the cordilleran flycatcher, flammulated owl, and Williamson's sapsucker. These slight positive effects would not affect reproductive or foraging success of any of these species, or their habitat and population trends, because of the small amount of habitat within the project area relative to the much larger ranges of these species and because the effects would be subtle changes from the current condition over the long-term.

Quantity and quality of grassland habitat for ferruginous hawks, golden eagles, northern harriers, prairie falcons, and Swainson's hawks and their prey would continue to be decreased slightly, with continued tree encroachment. These slight negative effects would not affect reproductive

or foraging success of any of these species, or their habitat and population trends, because of the small amount of grassland habitat within the project area (~23 acres), relative to the much larger ranges of these species and because the effects involve subtle changes from the current condition over the long-term.

Quantity and quality of grassland habitat for the burrowing owl and chestnut-collared longspur would continue to be decreased slightly, with continued tree encroachment. These slight negative effects would not affect reproductive or foraging success of these species, or their habitat and population trends, because of the small amount of grassland habitat (~23 acres) within the project area relative to the much larger ranges of these species and because the effects would be subtle changes from the current condition over the long-term.

In the event of a high intensity stand-replacing wildfire, those species preferring dense forest conditions would have a slight negative effect. Those species that prefer more open forest or grassland habitat may have a slight positive effects. Because high intensity wildfire kills many trees, there would be an increase in habitat for species using snags.

Species of Local Concern - Various Bats

Allen's lappet-browed bat and Townsend's big-eared bat: Alternative 1 would not affect larger snags used by these species. This alternative would result in continued slight decreases in habitat heterogeneity. This effect would not likely affect insect prey abundance and diversity because of the subtle, long-term nature of the habitat changes. There would be no reduction in risk of stand-replacing fire and associated habitat destruction within and adjacent to the project area. Overall slight negative effects would not affect reproductive or foraging success of these species within the project area. There also would be no effects to habitat or population trends for these species because of this and the small area of habitat within the project area, relative to the much larger ranges of these species. In the event of a high intensity stand-replacing wildfire, existing snags would likely be consumed. Because many trees would likely be killed, more roosting habitat would be available over the longer term.

Alternative 2 – Proposed Action

Dead woody debris and live fuel loading is variable across the project area (Fuels and Fire Effects section of this Chapter). As a result, different areas would likely receive uneven positive and negative effects from prescribed burning, depending on the size and arrangement of the fuels.

Federally Listed Species

Bald eagles: There are no bald eagle nest sites within the project area. Winter roost sites occasionally occur away from open water in protected sites, such as small canyons or draws, among a stand of large living ponderosa pine trees with large 'windows' in the canopy. Such roost sites are possible in the Twin project area, most likely along draws on the southern slopes of Bill Williams Mountain. Mitigation measures are included to protect large ponderosa pine trees that may serve as roost trees. No disturbance would occur to winter roosting birds because treatments are not likely to be conducted during climatically severe mid-winter, when such sites are likely to be used by bald eagles. No effects would occur to the bald eagle because loss or modification of winter roosts is not anticipated under the proposed action.

Mexican spotted owl: The proposed action would result in long-term increases in late-seral mixed conifer habitat within the project area as the number of large trees increase. Quality of this habitat for the MSO would incur both positive and negative effects. Positive effects to quality of late-seral mixed conifer habitat include increased abundance, vigor, and longevity of large trees and increases in snag densities over time. Negative effects include decreased presence of larger logs, decreased canopy closure, and short-term decreases in larger snags.

Other key effects to the MSO and its habitat from the proposed action include the following: a) reduced risk of stand-replacing fire and associated MSO habitat destruction within and adjacent to the project area, including the Bill Williams PAC and other MSO habitat; b) increases in the abundance, vigor, and longevity of large oak trees in pine-oak (MSO restricted) habitat, that are important nesting and roosting habitat components; and c) increases in abundance and vigor of grasses, forbs, and shrubs used by MSO prey species.

Because the proposed action would result in some negative effects to key habitat components and primary constituent elements, the proposed action may adversely affect the MSO and its critical habitat as discussed in the Biological Evaluation for Endangered Species Act Section 7 Consultation on the Mexican Spotted Owl and its Critical Habitat within the Twin Project Area, January , 2005 (PR #77).

Analysis of effects to MIS indicator habitat and population trends: There are only 27 acres of late-seral mixed conifer habitat in the project area compared with 1,550 acres of late-seral mixed conifer on the Forest (approximately 2%). Past MSO surveys have been negative in both the project area and all MSO habitat within ½ mile of the project area. Because of this, there would be no effect to Forest MSO populations, little effect to Forest MSO habitat, and no effects on the Forest MSO population and habitat trends.

Sensitive Species

Navajo Mountain Mexican voles: Ponderosa pine-savannah preferred by this species would slightly be restored and would incur a reduced risk of high intensity wildfire. This would have no effect to the species habitat or population trend, because the species is not known to occur within the project area and because of the small area of savannah within the project area relative to the much larger range of this species.

Northern goshawk The proposed action would result in long-term increases in late-seral ponderosa pine habitat within the project area as the number of large trees increase. Quality of this habitat for the goshawk would incur both positive and negative effects. Positive effects to quality of late-seral ponderosa pine habitat for the goshawk include increased abundance, vigor, and longevity of large trees, an increase in large snags over the long-term, and increased habitat heterogeneity. Negative effects include decreased numbers of larger logs and short-term decreases in large snags.

Other key effects to the goshawk and its habitat from the proposed action include the following: a) reduced risk of stand-replacing fire and associated goshawk habitat destruction within and adjacent to the project area, and b) increases in abundance and vigor of grasses, forbs, and shrubs used by goshawk prey species.

Positive effects to important goshawk habitat features include long-term increases in large trees, habitat heterogeneity, and grasses, forbs, and shrubs, along with decreased risk of stand-

replacing fire are slightly offset by short-term losses of larger logs and snags. The overall effect of the proposed action would therefore be positive for the goshawk, likely resulting in increased foraging and reproductive success for the goshawk within the project area.

Analysis of effects to MIS indicator habitat and population trends: As there are only 1,627 acres of late-seral ponderosa pine habitat in the project area compared with 100,735 acres of late-seral ponderosa pine habitat on the Forest (approximately 2%), there would be little effect to Forest goshawk populations and habitat, and no effects on the Forest goshawk population and habitat trends.

Management Indicator Species

Rocky Mountain Elk: The proposed action would result in decreases in early-seral ponderosa pine and mixed conifer habitat from prescribed fire treatments. The quality of habitat for elk would decrease as calving cover would become be reduced. Cover along important travel areas identified within the project area by AGFD would be retained, thereby minimizing effects.

Other key effects to the elk and its habitat from the proposed action include the following: a) reduced risk of high intensity wildfire and associated loss of grassland vegetation used as elk forage within and adjacent to the project area; and b) increases in abundance and vigor of grasses, forbs, and shrubs that serve as elk forage and browse throughout the project area. These effects may positively influence elk foraging and reproductive success within the project area, though these effects would be countered slightly by slight negative effects on calving cover discussed above. Because elk populations are managed through AGFD hunting permits, and because of the small area of grassland and openings in the project area relative to areas available to the elk population, these overall positive project-related effects on the elk are not likely to be observed at the population level.

Analysis of effects to MIS indicator habitat and population trends: There are 2,800 and 48 acres of early-seral ponderosa pine and early-seral mixed conifer habitat in the project area, respectively, compared with 15,400 and 1,050 acres of habitat on the Forest (approximately 16% and 4% respectively). As a result, there would be little effect to Forest elk populations and habitat, and no effects on the Forest elk population and habitat trends.

Mule deer: The proposed action would result in slight increases in quantity and quality of early-seral aspen and slight decreases in the quantity of early-seral pinyon-juniper habitat in the project area. The quality of early-seral pinyon-juniper habitat may be also be decreased as small, early-seral trees are thinned by fire. However, the reduction in pinyon and juniper trees through prescribed fire would increase the vigor and abundance of important browse plants, resulting in a positive effect for the mule deer. In addition, early-seral pinyon-juniper within important travel areas identified within the project area by AGFD would be retained, thereby minimizing effects. Other key effects to the mule deer and its habitat from the proposed action include the following: a) reduced risk of stand replacing wildfire and associated loss of mule deer habitat within and adjacent to the project area; and b) increases in abundance and vigor of shrubs that serve as mule deer browse throughout the project area.

Overall positive effects of the proposed action may positively influence mule deer foraging success within the project area. Though these effects are not likely to be observed at the population level because of the following: a) mule deer populations are managed through AGFD hunting permits; b) there is a small area of early-seral aspen and early-seral pinyon-

juniper relative to such areas available to the mule deer population; and c) mule deer are habitat generalists, using a variety of habitats in addition to early-seral aspen and pinyon-juniper.

Analysis of effects to MIS indicator habitat and population trends: As there are only 2 and 791 acres of early-seral aspen and early-seral pinyon-juniper habitat in the project area, respectively, area compared with 2,815 and 4,318 acres of such habitat on the Forest (less than 1% and 18%, respectively), there would be little effect to Forest mule deer populations and habitat, and no effects on the Forest mule deer population and habitat trends.

Tassel-eared Squirrel: The proposed action would result in a reduced risk of stand-replacing fire and associated potential for loss of squirrel habitat within and adjacent to the project area. Ponderosa pine is dependent on frequent, low-severity fire for maintenance and reproduction. The immediate effect of low-intensity fire in ponderosa pine on tassel-eared squirrel is negligible. Prescribed fire in ponderosa pine would reduce woody understories and encourage growth and productivity.

Analysis of effects to MIS indicator habitat and population trends: As there are only 8,025 acres of mid to late-seral ponderosa pine in the project area compared with 328,045 acres of such habitat on the Forest (approximately 2 percent), there would be little effect to Forest tassel-eared squirrel populations and habitat, and no effects on the Forest tassel-eared squirrel population and habitat trends.

Turkey: The proposed action would result in long-term increases in late-seral ponderosa pine habitat within the project area as increased growth contributes to the numbers of large trees. Quality of this habitat for the turkey would improve with increased abundance, vigor, and longevity of large trees.

Other key effects to the turkey and its habitat from the proposed action include the following: a) reduced risk of stand-replacing fire and associated turkey habitat destruction within and adjacent to the project area; b) increases in abundance and vigor of grasses, forbs, and shrubs used as forage and cover by turkey and turkey insect prey; and c) increased habitat heterogeneity that will promote small intermittent grassy patches within the forest that would be used for foraging by turkey. Reduced turkey cover from loss of logs and other down woody debris will be offset by increased turkey cover from increased shrub vigor and abundance. Positive effects to turkey habitat features (large trees, habitat heterogeneity, and grasses, forbs, and shrubs) along with a decreased risk of stand-replacing fire would be positive for the turkey, likely resulting in increased foraging and reproductive success within the project area.

Analysis of effects to MIS indicator habitat and population trends: As there are only 1,627 acres of late-seral ponderosa pine habitat in the project area compared with 100,735 acres of late-seral ponderosa pine habitat on the Forest (~ 2%), there would be little effect to Forest turkey populations and habitat, and no effects on the Forest turkey population and habitat trends.

Hairy woodpecker: The proposed action would result in short-term decreases in the larger snag component within ponderosa pine and mixed conifer habitats within the project area. Therefore, larger snag densities, and quality of these habitats for the hairy woodpecker would decrease in the short term. Prescribed fire would result in some tree mortality, so that there would be some recruitment of snags over the longer-term. In addition, measures are included in the proposed action to prevent the loss of snags from prescribed fire. The proposed action would also reduce the risk of stand-replacing fire and associated hairy woodpecker habitat destruction within and

adjacent to the project area. Negative short-term effects to snag densities for the hairy woodpecker, offset some by decreased stand-replacing fire risk, would have an overall slight negative effect on hairy woodpecker foraging and reproductive success within the project area.

Analysis of effects to MIS indicator habitat and population trends: There are 10,844 and 183 acres of ponderosa pine and mixed conifer habitat, respectively, in the project area compared with 343,416 and 21,888 acres of such habitat on the Forest (~3% and less than 1%, respectively). As a result, there would be little effect to Forest hairy woodpecker populations and habitat, and no effects to the Forest hairy woodpecker population and habitat trends.

Red-naped (yellow-bellied) sapsucker: The proposed action would result in slight increases in quality, but no changes in quantity, of late-seral aspen habitat within the project area from aspen restoration treatments. Snags within aspen would not be affected. The proposed action would result in reduced risk of stand-replacing wildfire within the project area, which would result in both positive and negative effects to red-naped sapsucker habitat. A stand-replacing wildfire would decrease the availability of aspen snags important for nesting, but, over time, would improve aspen habitat quantity and quality. A stand-replacing wildfire also would reduce availability of large conifer sap trees important for foraging by the species. Effects of the proposed action on aspen habitat would not affect foraging and reproductive success for the red-naped sapsucker within the project area, owing to the small amount of aspen and the slight degree of effects.

Analysis of effects to MIS indicator habitat and population trends: As there are only 2 acres of late-seral aspen habitat in the project area compared with 280 acres on the Forest (less than 2 percent), there would be little effect to Forest red-naped sapsucker populations and habitat, and no effects on the Forest red-naped sapsucker population and habitat trends.

Pygmy Nuthatch: The proposed action would result in long-term increases in late-seral ponderosa pine habitat within the project area as increased growth contributes to the number of larger trees. Quality of habitat for the pygmy nuthatch would improve with increased abundance, vigor, and longevity of large trees and recruitment of large snags over time. The proposed action would also reduce the risk of stand-replacing fire and associated pygmy nuthatch habitat destruction within the project area, as well as adjacent to the project area. Long-term positive effects to pygmy nuthatch habitat would result in increased foraging and reproductive success for birds within the project area over time.

Analysis of effects to MIS indicator habitat and population trends: As there are only 1,627 acres of late-seral ponderosa pine habitat in the project area compared with 100,735 acres of late-seral ponderosa pine habitat on the Forest (~2%), there would be little effect to Forest pygmy nuthatch populations and habitat, and no effects on the Forest pygmy nuthatch population and habitat trends.

Migratory Birds of Concern

The risk of habitat loss from stand replacing wildfire would be reduced for all species, except for the Lewis' woodpecker, which uses burned trees for nesting and foraging.

The proposed action would result in increased presence of openings and edge habitat, as well as increased habitat heterogeneity, preferred by the black-throated gray warbler, Grace's warbler, Virginia's warbler, olive warbler, red-faced warbler, Lewis' woodpecker, buff-breasted

flycatcher, olive-sided flycatcher, greater pewee, pinyon jay, and purple martin. For the Lewis' woodpecker, olive-sided flycatcher, and purple martin, these positive effects would be balanced by negative effects from short-term losses, followed by longer-term recruitment of snags. For the other species that prefer more open, heterogeneous habitats, positive effects would result in improved reproductive and foraging success within the project area. These effects would not affect habitat and population trends of these species because of the small amount of habitat within the project area relative to the much larger ranges of these species.

The proposed action would slightly decrease canopy cover, tree densities, and short-term large snag densities that are preferred by the cordilleran flycatcher, flammulated owl, and Williamson's sapsucker. These negative effects would result in reduced reproductive and foraging success within the project area for these three species. These effects would not affect habitat and population trends of these species because of the small amount of habitat within the project area relative to the much larger ranges of these species.

Quantity and quality of grassland habitat for prey species of ferruginous hawks, golden eagles, northern harriers, prairie falcons, and Swainson's hawks would be slightly improved. These positive effects may improve reproductive and foraging success of these species within the project area, though such improvements are likely to be minimal given the small amount of grassland habitat within the project area. These effects would also not affect habitat and population trends of these species because of the small amount of habitat within the project area relative to the much larger ranges of these species.

Prescribed burns would temporarily increase the quality of grasslands for burrowing owls and chestnut-collared longspurs because these species prefer grasslands with less cover for nesting and foraging. However, as vigor and abundance of grasses, forbs, and shrubs increase beyond current levels, habitat quality would decrease for these species. These delayed negative effects would not affect reproductive or foraging success of these species within the project area because of the small amount of grassland habitat within the project area and the balancing nature of positive effects from increased quantity of grasslands within the project area. These effects would not affect habitat and population trends of these species because of the small degree of effects and the small amount of habitat within the project area relative to the much larger ranges of these species.

Species of Local Concern - Various Bats

Allen's lappet-browed bat and Townsend's big-eared bat: The proposed action would result in short-term losses, followed by longer-term recruitment of larger snags used by these species. The negative effect would be balanced by increased insect prey abundance and diversity from increased habitat heterogeneity as well as reduced risk of stand-replacing fire and associated habitat destruction within and adjacent to the project area. Therefore, there would be no effects to reproductive or foraging success of these species within the project area. There also would be no effects to habitat or population trends for these species because of this and the small area of habitat within the project area, relative to the much larger ranges of these species.

Cumulative Effects on Wildlife

Cumulative effects on wildlife are those that occur from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future activities. The cumulative effects analysis area addresses a landscape scale including the Sycamore Canyon, Cataract, Spring Valley, Ash Fork Draw-Jumbo Tank, Hell Canyon, and Grindstone Wash-Upper

Verde 5th Code Watersheds. This area also encompasses home ranges of individuals that have the potential to be affected by the proposed action. The cumulative effects time period covers 30 years, from 1985 to 2015.

Activities and Projects Included in the Analysis

Listed below are key activities within the cumulative effects analysis area that are considered relevant in assessing cumulative effects.

Thinning

Thinning of small and medium-diameter pines increases habitat heterogeneity, abundance and vigor of understory vegetation (grass, forbs, shrubs, aspen shoots), and growth and vigor of larger trees, while it decreases canopy interconnectedness, small conifer tree cover, and the risk of stand-replacing fire and associated wildlife habitat destruction. Past, ongoing, and reasonably foreseeable thinning projects include the following vegetative treatment, grassland improvement, and aspen restoration projects: Beacon, Elk-Lee, Round-Oak-Tule, Dogtown, Frenchy, Reneke, Clover High, Marteen, Williams High Risk, KA Hill Fire Surrogate, Government, Ebert, Brannigan, Spring Valley, Potato Hill, Smoot Lake, Juan Tank, Eagle, Hardy, North Bull Trap, Polson, Homestead, Northwest Hat, Monte Carlo, Pedigo, Antelope Tank, Signal Hill, Government Mountain Aspen Restoration, Coleman Lake Aspen Restoration, Aspen Hill Aspen Restoration, Big Springs Aspen Restoration, Spring Valley Aspen Restoration, Wright Hill Aspen Restoration, Road 107 Aspen Restoration, and Little Pine Flat Aspen Restoration projects. These projects encompass a total of approximately 26,540 acres of vegetation treatment, 6,640 acres of grassland restoration, and 104 acres of aspen restoration within the analysis area.

Prescribed Fire

Prescribed fire increases habitat heterogeneity, abundance and vigor of understory vegetation, and growth and vigor of larger trees from decreased competition from smaller trees, while it decreases canopy interconnectedness, small conifer tree cover, and the risk of stand-replacing fire and associated wildlife habitat destruction. Past, ongoing, and reasonably foreseeable prescribed fire activities are: Beacon, Elk-Lee, Round-Oak-Tule, Frenchy, Pineaire, Clover High, El Paso, Williams High Risk, KA Hill Fire Surrogate, Government, Brannigan, Spring Valley, Twin, Government Prairie Burn, and Kendrick Burn. Within the analysis area 36,430 acres have been burned with prescribed fire over the past 15 years and an additional 45,000 acres are planned in the next 10 years.

Domestic Livestock Grazing

Historic domestic livestock grazing has altered understory vegetation within the analysis area. More recent past, present, and reasonably foreseeable livestock management actions within the analysis area indicate an improving trend in the abundance and vigor of understory vegetation. Past, ongoing, and reasonably likely future National Environmental Policy Act (NEPA) decisions for domestic livestock grazing include the following allotments: Big Springs, Garland Prairie, Hat, Homestead, Davenport Lake, Tule, Sitgreaves, Spitz Hill, Chalender, Bellemont, Government Prairie, Pomeroy, and Twin Tanks. These allotments cover approximately 286,000 acres within the analysis area.

Estimated Cumulative Effects of the Proposed Action

Table 4 shows the additive cumulative effects of proposed action on wildlife species, habitat features and trends when combined with the above past, present, and foreseeable projects.

Table 4. Estimated Cumulative Effects of the Proposed Action on Wildlife Habitat Features and Trends, and Wildlife Species

Habitat Feature and Associated Species	Effects from Past, Present, and Foreseeable Projects	Additive Effects of the Proposed Action
Habitat Heterogeneity **Species affected:** northern goshawk, turkey, black-throated gray warbler, Grace's warbler, Virginia's warbler, olive warbler, red-faced warbler, Lewis' woodpecker, buff-breasted flycatcher, olive-sided flycatcher, greater pewee, pinyon jay, purple martin, Allen's lappet-browed bat, and Townsend's big-eared bat.	Led to an increasing trend in habitat heterogeneity in the analysis area, which increases foraging, reproductive success and/ or survival of affected species.	Contributes to habitat heterogeneity.
Abundance & Vigor of Understory Vegetation (grass, forbs, shrubs, aspen shoots) **Species affected:** Mexican spotted owl, Navajo Mountain Mexican vole, northern goshawk, pronghorn antelope, elk, turkey, ferruginous hawks, golden eagles, northern harriers, prairie falcons, Swainson's hawks red-naped sapsucker, and mule deer.	Led to an increasing trend in abundance and vigor of understory vegetation in the analysis area, which increases foraging, reproductive success, and/or survival of affected species	Augment the increasing trend.
Growth & Vigor of Large Trees **Species affected:** Mexican spotted owl,, northern goshawk, tassel-eared squirrel, turkey, red-naped sapsucker, pygmy nuthatch.	Led to a slightly increasing trend in this habitat feature in the analysis area, owing to reduced competition from smaller trees, which increases foraging, reproductive success, and/or survival of affected species.	Augment the slightly increasing trend.
Canopy Interconnectedness **Species affected:** tassel-eared squirrel, cordilleran flycatcher, flammulated owl, and Williamson's sapsucker	Led to a reduction in canopy interconnectedness in the analysis area, which contributes to a decrease in foraging, reproductive success, and/or survival of affected species	Further reduces canopy interconnectedness.

Habitat Feature and Associated Species	Effects from Past, Present, and Foreseeable Projects	Additive Effects of the Proposed Action
Small Conifer Tree Cover **Species affected:** Rocky Mountain elk.	Led to a decrease in calving cover for the elk. No effect to elk reproductive success, owing to the continued abundance of this habitat feature across the analysis area and because availability of grass forage and water are more limiting for the elk.	Further reduces small conifer tree cover with no effect to elk reproductive success.
Log Abundance **Species affected:** MSO, northern goshawk, and turkey.	Led to a decreasing trend in this habitat feature in the analysis area. Log recruitment from bark beetle and prescribed and natural fire tree mortality has slightly offset this decreasing trend.	Slightly decreased by the proposed action.
Snag Abundance **Species affected:** Mexican spotted owl, northern goshawk, hairy woodpecker, red-naped sapsucker, pygmy nuthatch, Allen's lappet-browed bat, Lewis' woodpecker, olive-sided flycatcher, purple martin, cordilleran flycatcher, flammulated owl, and Williamson's sapsucker	led to a decrease in this habitat feature in the analysis area. Snag recruitment from bark beetle and prescribed and natural fire tree mortality has slightly offset this trend. Short-term slight decreasing effects	Additional short-Term decreases in snag abundance. Negligible long-term effect, as snag recruitment from proposed-action related tree mortality increases snag abundance back toward current levels.
Risk of Habitat Loss from Stand-Replacing Fire **Species affected:** All species	Led to a decreasing risk of stand replacing fire in the analysis area. Decreasing risk of habitat destruction, and associated reductions in foraging, and/or reproductive success	Augment the decreasing trend.

Threatened, Endangered, Proposed, and Sensitive Plants

Existing Condition

There are no known Threatened, Endangered, or Proposed (TEP) plant species on the Williams Ranger District. A Conservation Agreement between the US Forest Service and the US Fish & Wildlife Service protects Arizona bugbane and its habitat, with the intent of preventing the need for listing (USDI and USDA 1999).

The Forest Service Regions maintain lists of sensitive species that are not listed by USFWS, but are considered rare or vulnerable on federal forests (FSM 2670.5 (19)). The lists identify both those forests that are known to support a species and those where the species is unknown but potential suitable habitat appears to exist. The following table is a list of Kaibab National Forest species. It excludes those species that may occur on the North Kaibab Ranger District, but for which there is clearly no habitat on the Tusayan or Williams Districts.

Table 5. Forest Service Region 3 Sensitive Plant Species that may occur on Williams and Tusayan Districts of the Kaibab National Forest.

Common Name	Scientific Name	Possible Suitable Habitat	No Suitable Habitat
Mt. Dellenbaugh sandwort	*Arenaria aberrans*	X	
Gumbo milkvetch	*Astragalus ampullarius*		X
Marble Canyon milkvetch	*Astragalus cremnophylax v. hevronii*		X
Cliff milkvetch	*Astragalus cremnophylax v. myriorraphis*		X
Rusby's milkvetch	*Astragalus rusbyi*	X	
Kaibab paintbrush	*Castilleja kaibabensis*		X
Tusayan rabbitbrush	*Chrysothamnus molestus*		X
Arizona bugbane	*Cimicifuga arizonica*	known to occur	
Utah solitaire lily	*Eremocrinum albomarginatum*		X
Cliff Fleabane	*Erigeron saxatilis*	?	X
Morton wild buckwheat	*Eriogonum mortonianum*		X
Flagstaff pennyroyal	*Hedeoma diffusum*		X
Kaibab bladderpod	*Lesquerella kaibabensis*		X
Mt. Trumbull beardtongue	*Penstemon distans*		X
Flagstaff beardtongue	*Penstemon nudiflorus*	known to occur	
Grand Canyon rose	*Rosa stellata ssp. abyssa*		X
Arizona sneezeweed	*Helenium arizonicum*		X
Chiricahua dock	*Rumex orthoneurus*		X

Arizona bugbane occurs on the Williams Ranger District, in two humid, shady, north-facing drainages on Bill Williams Mountain. The populations are located at approximately 8,000 feet, in an area dominated by mixed conifer and aspen. Other drainages on the north side of the mountain that may provide suitable habitat have been surveyed repeatedly, with negative results. The Twin project extends up the lower southern slopes of Bill Williams Mountain; it does not include any bugbane habitat.

Flagstaff beardtongue occurs in the western part of the project area (Crisp, pers. com. 2001). There is suitable habitat interspersed throughout the project area. There have been no comprehensive surveys for Flagstaff beardtongue.

Rusby's milkvetch and Mt. Dellenbaugh sandwort have been documented on or very near the Williams RD. There appears to be potential habitat for them in the project area, but no populations have ever been located.

Direct and Indirect Effects to TES Plant Species

Alternative 1 - No Action

The woodlands and forest would become denser and shadier. Increased shading would decrease sandwort and beardtongue vigor and longevity. Reproductive success would decline and species would gradually be extirpated from the project area. The effect on Rusby's milkvetch is unknown. There would be no project-related mechanical impacts on plants.

No action increases the likelihood of high intensity wildfire, leading to large losses of tree canopy and extensive areas of bare soil. Fires originating on the south side of Bill Williams Mountain could easily engulf the entire mountain, including the bugbane population. High intensity wildfire could kill some or all bugbane, sandwort, beardtongue, and milkvetch plants. Loss of canopy would be detrimental to Arizona bugbane, which requires shade. Short-term and long-term soil changes, such as hydrophobicity, death of soil microbe populations, and reduced organic matter inputs, could delay or prevent re-establishment of any of the sensitive species. Fire suppression activities could physically damage populations and directly alter suitable habitat.

Alternative 2- Proposed Action

Potential habitat for beardtongue, milkvetch, and sandwort occurs throughout the project area. Low-intensity prescribed burning could kill or damage some plants, but is unlikely to eradicate entire populations. Long-term effects of opening up the woodlands would be beneficial to sandwort and beardtongue. The potential effect to Rusby's milkvetch is unknown. Mitigation measures in the proposed action would prevent mechanical damage to known populations during project implementation.

The Proposed Action decreases the likelihood of a high-intensity wildfire, which is the greatest threat to the survival of all the sensitive plant species and their habitats.

Cumulative Effects

The cumulative effects analysis area for TES plant is all of the pine-oak, pinion pine and associated grassland and mixed conifer vegetation types mapped in the Terrestrial Ecosystem Survey on the Williams Ranger District. The timeframe analyzed is from 1990 to 2015. Past and ongoing uses and action within the analysis area that may affect sensitive plant species include livestock grazing, logging and thinning, juniper control/grassland restoration, fireline construction, slash piling, stock tank maintenance, road maintenance, off-road vehicle travel, and residential development. Except for the campground renovation and off-road vehicle travel, all of these uses are expected to continue indefinitely into the future. Specific past and current projects in the analysis area that may have impacted sensitive plant species include Beacon, Round-Oak-Tule, Reneke, Elk-Lee, Dogtown, Frenchy, Clover High, Marteen, Williams High Risk, Brannigan, Spring Valley, Signal Hill, Pineaire, Barrier, and Kendrick-Newman. Future tree thinning and underburning proposed for lands in the analysis area are McCracken and City. Any of these activities may degrade habitat or directly damage or kill any existing plants, but will have long-term beneficial effects on all sensitive plant habitats.

The only suitable habitat for Arizona bugbane in the cumulative effects analysis area occurs in the City project. Flagstaff beardtongue occurs along roadsides in the Twin fuels management

project area, There is potential habitat for the sandwort, milkvetch, and beardtongue in the analysis area, but populations of these species are unknown.

Future fuels treatments on Bill Williams Mountain will provide further protection from high intensity wildfire to Arizona bugbane. Mitigation measures in the proposed action (and in the other projects in the cumulative effects analysis area) provide for avoidance of mechanical disturbance around sensitive plant populations should any be discovered. This, and the likely improvement of habitat as a result of the project, assures that the project will not add significantly to ongoing impacts. The project may cause short-term impacts to habitat or populations, but is not likely to result in long-term loss of population viability.

Noxious Weeds

Dalmation toadflax (*Linaria dalmatica*) currently occurs in several areas within and adjacent to the proposed project area. All of the areas are on sites that have been previously disturbed by fire, tree cutting, powerlines, and/or roads. Species that are known to have occurred within the greater project area are bull thistle, scotch thistle, Dalmatian toadflax, tamarisk, yellow star thistle, and jointed goatgrass.

Some of the small populations of noxious weeds are currently being controlled by hand-digging. Other options for treating large populations are discussed in a plan for integrated treatment of noxious and invasive weeds (USDA Forest Service 2005). Initial implementation of this plan is expected to begin in 2005.

Direct and Indirect Effects on Noxious Weeds

Alternative 1- No Action

In the No Action alternative, no additional existing noxious weeds would be targeted for treatment. They would likely gradually expand beyond their current range, invading undisturbed areas. As long as soil disturbance remains at or below its current level, there would be no increase in potential for introduction of new populations and species. However, if there is no action, the likelihood of severe, destructive fire continues to increase. When that fire occurs, it will create hundreds or thousands of acres of unshaded bare soil, excellent noxious weed habitat. In the aftermath of the Pumpkin Fire, 2000, pre-existing weed populations on Kendrick Mountain exploded. Their density and range greatly increased, and now threaten the ecological integrity of the Kendrick Mountain Wilderness. This would be a concern for many years, until the native vegetation re-establishes enough to successfully compete for space, light, and nutrients.

The effect of the No Action alternative on noxious weeds is to avoid or postpone control treatments and to create the opportunity for long term, widespread invasion.

Alternative 2- Proposed Action

In the Proposed Action, most of the project would be treated through underburning, with some mechanical thinning in the fireline preparation areas and safety zone areas. Activity slash in these areas would be piled, lopped, or shredded. This could be done by bulldozer or other machinery, or by hand. There would be many opportunities for small-scale soil disturbance, which would increase noxious weed habitat. However, the disturbance would be a mosaic of small patches, not large continuous swaths. Treatments should result in improved understory vigor, as well as

assure that sufficient overstory remains for litter inputs. Additionally, the watershed will be protected from degradation through the implementation of Best Management Practices. These mitigating factors will encourage rapid natural healing of bare soils, thus providing noxious weeds a very brief window of opportunity to spread.

Mitigation measures in the proposed action specifically require actions to control the introduction of new weeds, to control the spread of existing weeds, and to monitor the area post-project so that further weed control can be done as necessary.

The effect of the Proposed Action on noxious weeds is to treat existing and near-future populations and to allow a short-term, small-scale increase in available habitat and/or colonization.

Cumulative Effects of the Proposed Action

The cumulative effects analysis area for noxious weeds is the Williams Ranger District. The time period for the analysis begins in 1997 and continues through 2015. The first records of noxious weeds in the District were made in 1997. Weeds were most likely present prior to that, but there is no data on which, where, and how many. Throughout the District, noxious weed populations are most common immediately adjacent to roadsides and in old burn piles from timber treatments. While it's impossible to determine exactly which past projects, routine maintenance, or visitor activity facilitated the establishment of the plants, it's clear that they are the result of human actions. Aside from the area affected by the Pumpkin Fire, weed expansion on the Williams RD is slow but steady. Past projects that may have influenced noxious weed introduction and establishment are Beacon, Marteen, Spring Valley, Government Prairie, Barrier, Pineaire Brannigan, and Round-Oak-Tule. Current and future management actions are opportunities to positively (or negatively) influence the impact of noxious weeds on forest resources. Future projects adjacent to Twin are City and McCracken. Both projects are similar to Twin in that they will use burning, thinning, or both to restore forest structure and treat natural fuels. Small populations of noxious weeds, primarily Dalmatian toadflax, occur in each of the proposed project areas. Each of the projects includes, or will include, required mitigation actions to control, prevent and monitor weeds. Each project would incrementally increase the area protected from high-severity- wildfire created habitat.

An integrated weed management plan has been jointly developed by the Coconino, Kaibab, and Prescott National Forests (USDA Forest Service 2005). Among other things, the plan prioritizes invasive species for treatment, and sets the stage for weed control projects independent of other projects. This assures that species and areas that might not be included in projects, such as Wilderness Areas and Research Natural Areas, are still scheduled for treatment. The EIS presents treatment goals and strategies for a ten year period, 2005 to 2015.

The cumulative effects of the Proposed Action are to increase the continuous land mass that is resistant to fire-created noxious weed habitat and to increase the area actively managed to prevent weed introductions and reduce or eradicate existing noxious weed populations.

Range and Understory Vegetation

The only grazing allotment directly affected by the Twin project is the Hat Allotment. Hat is a year-round cattle operation. The grazing schedule is rest-rotation. This allows different pastures to be rested each year, and for each pasture to have annual variations in its season of use.

Vegetation in the project area is dominated by ponderosa pine–oak (73% of the project area) and pine-pinyon-oak woodland (19% of the project area). Pine-oak occurs throughout the project area, while pine-pinyon-oak is restricted to lower elevations or drier sites. Pine-pinyon-oak is frequently the transition vegetation between pine-oak and pinyon-juniper or grasslands. Arizona fescue is the primary grass in pine-oak ecosystems; mountain muhly and muttongrass are also consistently present. Characteristic forbs are yarrow, false loco, silver lupine, pussytoes, and mullein. The most common grass in pine-pinyon-oak is blue grama, accompanied by Arizona fescue, muttongrass, and squirreltail. The most common forbs are yarrow and silver lupine.

Other vegetation types in the area include Douglas fir and mixed conifer forest (2%), pinyon/juniper, oak scrub, and chaparral (4%), dry shrub-steppe/grassland (<1%), mesic grassland (<1%). Less than 1% of the project area is covered by water (reservoirs and stock ponds).

All of the wooded vegetation types have been experiencing escalating crowding and shading since livestock grazing and fire suppression became common land management actions. Cover of understory vegetation, grasses and forbs, has steadily decreased as a result. Not only does this degrade the forage resource, it increases the vulnerability of the land to excessive soil erosion.

Direct and Indirect Effects on Range Resources

Alternative 1 - No Action

Trees would continue to expand into grasslands and become denser in woodlands. The resulting increased shading and competition for water and nutrients would cause a decrease in herbaceous and shrub diversity and abundance, which would decrease the amount and quality of forage available for livestock and would likely cause a downward trend in range condition. With increases in extent and continuity of bare soil, there would likely be increases in wind and water caused soil erosion. Soil loss decreases soil productive potential, leading to further decreases in herbaceous production.

In the event of extreme fire behavior, which is more likely to occur under the no action alternative than under the proposed action, the majority of the understory vegetation would likely be killed. Natural revegetation under these circumstances begins very slowly. It could easily be a decade before there was a meaningful supply of herbaceous forage for wildlife and livestock. It would be longer yet before browse species became useful.

Alternative 2 - Proposed Action

The proposed action would decrease tree density and canopy cover in woodlands and remove most trees from grasslands. The resulting increase in sunlight, water, and nutrients would allow greater development of herbaceous and shrub vegetation. An increase in cover and distribution would be the first noticeable effect, followed by an increase in species diversity. Low intensity burning generally benefits herbaceous plants, by removing dead and weak tissue that may be

shading or crowding plants, and by returning nutrients immobilized in litter and burned plants to the soil. Burned areas are rested for at least one full growing season after implementation, which allows herbaceous vegetation to take full advantage of increased nutrients and release from shading. Forage and browse resources for wildlife and livestock would likely improve in both quality and quantity.

The proposed action would decrease the potential of extreme fire behavior. This decreases the likelihood of near total destruction of understory vegetation. Ecological structure and function is more likely to be maintained or improved in the absence of extreme fire behavior. Though ecological condition is not directly correlated to range value, basic integrity of structure and function underlies the development of quality grazing resources.

Cumulative Effects

Activities within the Twin project boundary will affect range resources in the Hat Allotment. Past projects that that have influenced range resources in the Hat Allotment over the past 20 years are the Stage and Dutch Kid prescribed burns, and the Pine Springs timber sale. Additionally there was about 14,500 acres of juniper control projects that occurred from 1980-1988. Grazing has occurred on the allotment at least part of the time every year for the last 100 years. Opportunities for future juniper control projects are being evaluated but have not yet been identified. McCracken and City are upcoming fuels and vegetation treatment that will impact the range resources on the Hat Allotment. Tree thinning and underburning provide short to long-term benefits to grazing resources by increasing the amount and distribution of forage. Dispersed camping and off-road vehicle travel are currently unregulated on the allotment and periodically cause significant impacts to range vegetation. Off road vehicle travel generally decreases the amount and value of herbaceous vegetation, increases the amount of bare ground, and introduces undesirable species. The proposed project will have the cumulative effect of improving range condition where other uses have had negative impacts and increasing the number of acres that are more protected from stand replacing wildfire and associated range destruction.

Watershed and Soils

The Twin project overlaps the junction of four 5th code watersheds: Cataract Creek drains northward to the Colorado River, while Ash Fork Draw – Jumbo Tank, Grindstone Wash – Upper Verde and Hell's Canyon ultimately drain to the Verde River (PR # 90).

Most of the project area is gently to moderately sloping hills. Steeper slopes occur in the canyons that radiate away from Bill Williams Mountain, a six-million-year old lava dome at the northeast corner of the project area. Soils within the project area are generally volcanic. Outside the project area but within the cumulative watershed, sandstone and other sedimentary parent materials are exposed in the canyons and below the Mogollon Rim.

There are no perennial streams in the project area. There are numerous stock tanks, but none is reliably perennial. Approximately 203 acres of the Twin project lie within the Dogtown Reservoir sub-5th code watershed, which is a component of the City of Williams's municipal watershed. Runoff from these acres may reach Dogtown Reservoir, potentially affecting the quality of the City's domestic water supply. Sediment from upslope soil erosion is the only pollutant that would be produced during implementation of the Twin project.

The Arizona Department of Environmental Quality and Northern Arizona University's Lakes Program tested water quality in Dogtown Reservoir in 1999, 2001, and 2002. Most of the test results were inconclusive regarding whether the lake's waters are fully attaining or are not attaining the quality necessary to support the beneficial uses assigned to the lake by the state. Standards for fish consumption are being fully met and the lake has been assigned an "Attaining some Uses" rating. It is not on the Environmental Protection Agency's 303(d) list. Suspended sediments (turbidity) are high enough that the State is planning more intensive monitoring in order to determine if they are problematic and should be reduced (ADEQ 2004).

Soils within the project area were evaluated for erosion risk using information in the Terrestrial Ecosystem Survey (TES) of the Kaibab National Forest. Twenty-seven TES units occur on the project area; of these, thirteen are at high risk of accelerated soil erosion. Altogether, these high-risk units comprise approximately 4,800 acres, 33% of the proposed project area. They occur predominantly on steep mountain slopes, escarpments, and sidewalls of ephemeral drainages. Loss of vegetative ground cover (live and/or dead) is the primary trigger for excessive soil erosion.

Soils on slopes greater than 15% with high cinder contents are inherently unstable. Other slopes greater than 15% may not be naturally unstable, but are naturally vulnerable to increased erosion when vegetative ground cover is removed as a result of wildfire, storm events, or management actions. Slopes less than 15% are resistant to such events.

The current erosion rate is the annual soil loss occurring under current vegetation and litter cover conditions. In some soils, the current erosion rate is likely to already be exceeding the tolerance rate. Tolerance is the rate beyond which erosion causes long-term losses in soil productivity. When this is the case, hydrologic condition is considered to be unsatisfactory. According to the TES, soils in the Twin project that may be unsatisfactory occupy approximately 2,100 acres (14 percent of the project area). Not coincidentally, all of these acres are on greater than 15% slope and have insufficient vegetative cover to adequately protect the soil's surface. Within the entire project area, the average current erosion rate is 0.9 ton /acre/year (t/a/y). The average tolerance rate is 2.4 t/a/y. The average potential soil loss rate, which is what would be reached if all vegetative cover were removed, is 4.4 t/a/y.

Direct and Indirect Effects to Soil and Watershed Values

Alternative 1 - No Action

Ponderosa pine and juniper densities will continue to increase. This will create greater litter cover and depth on much of the forested project area. This would maintain or decrease vulnerability to soil erosion in the forested areas. Grasslands will likely experience an increase in conifer cover. Tree encroachment into grasslands usually results in decreased herbaceous cover, due to increased shading and competition for water and nutrients. This increases the risk of accelerated erosion. Because wood and the leaves of coniferous species break down much more slowly than grasses and herbaceous leaves and roots, grasslands are also subject to reduced nutrient cycling if there is an increase in trees.

No action will maintain or increase the project area's vulnerability to extreme fire behavior. Denuded steep slopes would experience greater and faster run-off and unsustainable accelerated erosion, while flat areas could flood or experience gully formation. The average potential rate of erosion on areas with greater than 40% slope is 16.5 t/a/y, more than seven times their average tolerance rate of 2.2 t/a/y. Most of these steep acres are currently in satisfactory condition, but if

even an additional 10% of their area loses its plant cover, their erosion rate will exceed the tolerance level.

Extreme heating of the soil surface during high intensity fire creates a hydrophobic layer that increases runoff, leading to additional increased soil erosion and deposition. Loss of vegetative canopy and litter cover increases raindrop impact on the soil, so more soil particles are detached and subject to erosion. It increases the delivery rate of precipitation through the watershed, so there is less opportunity for water to infiltrate the soil column. The result of this is increased runoff and decreased ability to support revegetation. Increased sediment delivery to perennial, intermittent, or ephemeral water sources can decrease water quality for wildlife and livestock . It could also degrade the quality of Dogtown Lake, part of William's domestic water supply. In the event of extreme fire behavior, nutrients that would normally be returned to the soil would instead be volatilized and released into the atmosphere. This would retard vegetative recovery, as well as decrease the nutritive value of forage for wildlife and livestock.

Alternative 2 - Proposed Action

Fire line construction and low-intensity fire behavior will cause some soil disturbance, which will likely lead to a short-term increase in bare soil and compaction. Assuming that 10% of the total project area is severely impacted by dozer piling and/or high fire intensity, the average current soil loss would increase to 1.3 t/a/y (from 0.9). That is still safely below the average tolerance rate of 2.4 t/a/y. The increased rate will likely persist for one to three years, by which time increased herbaceous cover will provide sufficient soil protection to return to lower levels. The proposed action would use Best Management Practices for Soils and Watershed (Forest Service Handbook 2509.22, Section 31), which are designed to protect areas with severe erosion hazards. In the mid and long term, thinning and low intensity burning will encourage establishment of understory grasses, forbs, and shrubs. These species retard erosion and contribute herbaceous litter to the soil system, improving nutrient and water cycling processes. Retarding erosion and improving water cycling help to maintain or improve water quality in the perennial, intermittent, and ephemeral water sources.

Forest thinning via low intensity burning decreases the risk of high intensity fire behavior. This protects soils from adverse precipitation affects associated with soil hydrophobicity and loss of vegetative litter and canopy. The proposed action may cause a temporary increase (1 to 3 years) in soil erosion to 1.3 t/a/y, whereas no action could ultimately cause an overall long-term (10+ years) increase to 4.4 t/a/y. Again, the project area's average tolerance rate is 2.4 t/a/y.

Based on the possibility of increasing the erosion rate within the Dogtown watershed portion of the project area to 1.3 t/a/y, up to an additional 94 tons per year of sediment could be produced. The current amount produced in the entire Dogtown Reservoir watershed is 1824 tons per year. So, for up to three years, sediment delivery to the lake could be increased by 5%. Due to the ephemeral nature of the drainages in the watershed, sediment is unlikely to be flushed immediately into the lake. The period of delivery would be spread out over a number of years, decreasing the amount impacting the lake in a single year. Implementing the BMPs will further decrease the amount of sediment leaving the project area. Twin would have no measurable impact the quality of the Williams municipal water supply.

Cumulative Effects

The boundary for the cumulative impact analysis is the watershed that drains to Dogtown Lake, McLellan Reservoir, Upper Meath Wash, Devil Dog Canyon, Upper Rattlesnake Canyon, Grindstone Wash, M-C Canyon, and Cougar Basin. This comprises approximately 115,000 acres.

All or portions of Bill Williams Mountain, Signal Hill, McLellan Reservoir, Dogtown Reservoir, Bixler Mountain, and the City of Williams are included in the cumulative analysis area. There are 8 grazing allotments that overlap the cumulative analysis area.

The time period for the cumulative effects analysis begins three years prior to implementation of the Twin project and ends three years after its completion. Three years is chosen because the Best Management Practices (BMPs) and mitigation measures that are part of each project in the watershed are intended to prevent or heal negative watershed impacts within three years. Twin implementation will likely occur over a three to five year period, with the possibility of later subsequent entries. If implementation begins in the Fall of 2005 and continues through 2007 to 2010, the analysis period would include any other projects in the area that are active or in the three-year recovery phase between 2003 and 2012. Timber and fuels management projects wholly or partially within the analysis area that are likely to overlap the Twin analysis period are portions of Dogtown, City, and McCracken. Burning and mechanical disturbance associated with each of these projects will cause some increased soil erosion. The average soil loss rate on the McCracken area for example, is 1.0 t/a/y when there are no impacts from projects. The rate rises to 1.3 t/a/y during active projects, and then gradually returns to the non-impacted rate over the three-year recovery period. There are also several grassland maintenance projects in the cumulative watershed, totaling almost 2,000 acres. These tend to have minimal ground disturbance, since the invading trees are simply cut off at ground level and left on the ground. For purposes of this analysis, however, they are treated as if they created 10% additional bare soil, so that cumulative effects can be estimated for the worst-case scenario.

The average background erosion rate within the analysis watershed is 1.33 t/a/y. During implementation of the projects listed above, excluding Twin, the rate is predicted to be 1.37 t/a/y. The cumulative impact of adding Twin to recent past, present, and near future activities in the watershed is an increase to 1.41 t/a/y. The average tolerance erosion rate for the analysis watershed is 2.32 t/a/y.

Within the Dogtown Reservoir watershed, City and McCracken projects potentially compound the amount of sediment delivered to the lake in years when they overlap with Twin. In the worst-case scenario, all three projects could contribute sediment in the same year. This could increase the watershed's current rate from 0.5 t/a/y to 0.7 t/a/y. The tolerance rate is 2.5 t/a/y. An additional 545 tons of sediment per year could theoretically enter Dogtown Lake, an increase of 30%. Given the lake's existing potential turbidity problem, an increase of 30% is unacceptable. However, because City and McCracken will be implementing BMPs, in addition to Twin, there will not be measurable sediment inputs to the lake. There will be no measurable impacts on water quality, including Williams' municipal supply.

There are a number of flagstone-quarrying operations in the southern part of the cumulative watershed. When each quarry is initially opened, a large amount of soil is exposed and disturbed. There is likely a short-term increase in soil loss from the site, accompanied by increased deposition in the ephemeral drainages below the quarries. There are no studies available that document the amount or rate of soil movement during this period. Actual excavation of the sandstone results in the quarries being internally drained, so there is no long-term increase in

runoff or erosion. Dirt roads servicing the quarries are subject to frequent use by loaded rock trucks. This is a potential source of chronic, accelerated erosion. However, the county and quarry operators (as a condition of their special-use permit) regularly maintain these roads, which limits excessive erosion. The Twin project occupies a very small percentage of the headwaters of watersheds containing quarries. There is a several mile separation between Twin and the quarries. It is unlikely that sediment from Twin will migrate to portions of the drainages affected by quarries, except in unusually extreme storm events. The cumulative effect of implementing Twin in watersheds with quarries is negligible.

Livestock grazing will continue on all the allotments within the analysis watershed throughout the analysis period. The effect of current grazing on soil erosion is already reflected in the current rate of soil loss. Management changes in the future can be expected to increase control over the location and degree of use. These changes are expected to improve vegetative cover and watershed condition, causing a decrease in the soil erosion rate.

The Twin project will cause a temporary increase in the rate and amount of soil loss, both within the project area and within the surrounding watershed. In both areas, overall, the increased rate will remain safely below the tolerance rates. Mitigation measures will protect specific sites where the risk of exceeding the tolerance level is high. Therefore, no loss of soil productivity or water quality is predicted.

Heritage

Affected Environment

Within the Twin Prescribed Burn Project area there are 99 known heritage resources. These include a wide variety of prehistoric artifact scatters, pueblos, rock art, historic cabins, abandoned logging railroad grades, and segments of abandoned Route 66. During the past 30 years, Heritage Resource specialists have conducted numerous inventories as a result of Sections 106 and 110 of the National Historic Preservation Act of 1966, as amended. These projects have inventoried 6,596 of the 14,616 project acres (45%). The clearances and recommendations for the Twin Burn project have been consolidated into several prescribed burn reports (PR #14 and 75).

Direct and Indirect Effects on Heritage Resources

Alternative 1 - No Action

The no action alternative will have no measurable direct or indirect effects on any heritage resources. However, under the no action alternative, fuels will continue to accumulate on heritage resource sites that could lead to these sites burning at higher temperatures should wildfires move through the project area.

Alternative 2- Proposed Action

Alternative 2 will have no measurable adverse effects to any heritage resources. Because most of the area is slated for low intensity prescribed burning, there will be no adverse effects to any of the artifact scatters. All fire sensitive sites, as defined in the WUI and Large Hazardous Fuels Reduction Projects Programmatic MOA (USDA and AZ SHPO 2003) will be protected as necessary. In particular, one site, a logging railroad grade with intact ties must be avoided by burning activities. Crews must remove fuels from this eligible segment of logging railroad that

dates to the late 1890s. Since Alternative 2 would reduce fuels on many prehistoric sites, there will likely be a reduction of threats from uncontrolled wildfires on heritage resources.

Cumulative Effects

Because there are no anticipated direct or indirect effects for Alternative 2 - Proposed Action, there would be no cumulative effects on Heritage Resources.

Recreation and Scenic Resources

Introduction

Recreation and scenic resources are related. High quality scenery and unique scenic resources are important to recreationists and are an integral part of high quality recreational settings. Highly attractive and scenic landscapes, and high quality recreational facilities and attractions can be important to quality of life. They also contribute to the success and growth of a vibrant tourism industry, contributing to the local economy.

Existing Conditions

Recreation Resources

Although the exact use numbers and patterns of use are not known, recreation use in the project area is estimated by South Zone recreation managers to be high, due to its location near the City of Williams, easy access, and attractions. Results from recent national and local visitor surveys (NVUM 2000, NAU 2001) indicate a large percentage of national forest visitors travel to the South Kaibab from the densely populated Phoenix Valley urban communities and Colorado River communities, from Las Vegas, Nevada, and other communities in Arizona. Many visitors from these lower elevation communities travel to the area to escape the intense summer heat, preferring to recreate in the cool high elevation pine forests.

Local residents are also a significant user group, as they have immediate access to the national forest. There is also a significant amount of recreation use by visitors originating from across the US and abroad. Williams is part of the widely advertised and marketed Southwest Region "Grand Circle" tour route, which includes nearby Grand Canyon National Park, attracting 4 to 5 millions visitors annually. Dubbed "The Gateway to the Grand Canyon," Williams has a history as a tourism destination in Northern Arizona, and development of the tourism industry has received increased emphasis in the past few decades.

Recreational use has been increasing steadily over time, and is expected to continue to grow across the Kaibab National Forest. According to national recreation use studies, nationwide recreational use of national forests is expected to increase at least at a rate comparable to the population growth rate nationwide. Identified as the two fastest growing states in the country, Arizona and Nevada are currently experiencing tremendous population growth, particularly in the Phoenix Valley and Las Vegas. Due to extremely high regional population growth rates in Northern Arizona, recreation use could increase even faster and the very high percentage of Arizonans who engage in outdoor recreational activities, specifically on national forest system lands.

As recreation use increases, the types of recreation activities visitors engage in are likewise increasing and diversifying. The types of recreational activities visitors pursue in the project area are varied, occurring in both developed and dispersed settings, and occurring across all seasons. Uses of the area include pleasure driving, viewing scenery and wildlife, studying and viewing historic resources such as Route 66, picnicking, taking photographs, dispersed camping, hiking, mountain biking, horseback riding, riding ATVs and motorcycles, hunting, snowshoeing, cross-country skiing, and participating in a variety of other snowplay activities. The area is a popular destination for both organized commercial group recreation events such as bicycle races and archery shoots, as well as non-commercial group uses such as family reunion and church group campouts.

In response to visitor demands, the Forest Service provides developed recreational facilities (trailheads, trails, campgrounds, interpretive sites, etc.), and undeveloped outdoor settings which provide opportunities for visitors to pursue a wide variety of recreational activities. There are a number of Forest Service developed recreation facilities and system trails located within or immediately adjacent to the project area. Developed recreation facilities and trails include Route 66 and Stage Station Loop mountain bike trails, and portions of the Benham and Bixler Trails. The Benham Trail is designated as a National Recreational Trail and Arizona State Heritage Trail, and the trailhead was developed with partnership funding from the Arizona State Heritage Fund. Many user-developed dispersed campsites can be found throughout the area, but are primarily concentrated along road corridors in suitable flat, open, and easily accessible areas, particularly along FR 122, 108, and near the Benham Trailhead.

National Forest visitors are diverse in their preferences for recreational settings, experiences, and activities, and for the reasons mentioned above, as well as changing demographics, are becoming even more diverse. In order to provide a diversity of settings and opportunities the Forest Service uses the Recreation Opportunity Spectrum (ROS) as a management tool to inventory and describe recreation setting objectives for national forest system lands. Forest Plan ROS mapping has recently been completed for the Williams and Tusayan Districts, and management guidance provided in the adjunct Kaibab National Forest Recreation Opportunity Spectrum and Scenery Management System Guidebook (Kaibab NF ROS/SMS Guidebook). There are three ROS classes within the Twin project area, including Roaded Natural ROS surrounding Bill Williams Mountain, Semi-Primitive Motorized further up the mountain slopes, and a small area of Semi-Primitive Non-Motorized located in the unroaded area at the summit of Bill Williams Mountain. Forest Plan direction states that ROS classes are to be considered in the design of project activities and ROS classes will be maintained or enhanced.

Table 6. ROS class acres in the Twin Burn Project area.

ROS Class	Acres in Project Area	General Setting Description (Desired Condition)
Roaded Natural (RN)	10,610 acres	Landscapes are carefully managed to maintain or enhance recreation and scenic values, sites and features, to be natural-appearing, with changes designed to appear in harmony with natural setting. May contain highly developed recreation sites and travel routes.
Semi-Primitive Motorized (SPM)	3,439 acres	Maintain predominantly undeveloped landscapes and scenic vistas as viewed from travel routes, with limited recreation developments.
Semi-Primitive Non-Motorized (SPNM)	571 acres	Predominantly undeveloped landscapes and scenic vistas and limited recreation developments. Recreation uses are non-motorized.

Scenic Resources

The Twin Project area surrounds Bill Williams Mountain from the northwest around the southern flanks ending approximately midway on its east flanks near Benham Trailhead. The project area is located on the lower and mid-slopes of Bill Williams Mountain and also includes Bixler Mountain. Bill Williams Mountain and Bixler Mountain contribute to the area's attractiveness as a recreation destination, and represent a significant component of the local community's scenic heritage, identity and image, contributing to its "sense of place". Given its location, much of the project area is highly visible and viewed by large numbers of people from heavily used travel corridors, including Interstate 40 on the west side of the project area, Historic Route 66 Highway, the Bill Williams Mountain Loop Road (FR108), County Road 73, Twin Springs Road (FR122), Bill Williams Mountain Road (FR111), and secondary travelways through the forest. The project area is also viewed from four system trails (Historic Route 66 and Stage Station Loop mountain bike trails, Benham and Bixler trails) located within and adjacent to the area, and from the high-use recreation developments at Dogtown Lake. In addition, private landowners with property within or adjacent to the project area view the surrounding landscape on a daily basis, and is likely very important to their quality of life.

Also of important are the "special areas" in the project area, which hold high value and meaning for visitors and local residents (spiritual, aesthetic, nostalgic, or other). Bill Williams Mountain, County Road 73 ("South Road", "Perkinsville Road"), Dogtown Wash and Lake, and the Loop Road (FSR 108) were all identified specifically as "special places" by respondents of the South Kaibab Visitor Survey (NAU 2001). The benefits of high-quality scenery are numerous despite the fact that a dollar value is seldom assigned to it except in regard to real estate appraisals and areas with major tourism influences. Some of the benefits of managing scenery include conservation of scenic heritage, quality of life, identify and self-image of communities and individuals, recreation and tourism settings.

Due to the high scenic and social value and interest in this area, the landscape surrounding Bill Williams Mountain is identified in the Kaibab Forest Plan as highly sensitive from a scenery management perspective. The Scenery Management System (SMS), adopted on the South Kaibab National Forest in 2004 through a forest plan amendment, provides the overall framework for the inventory, analysis, and management of scenery and scenic resources. The SMS inventories visual sensitivity, existing and desired landscape character and scenic integrity. Subsequent analysis and mapping of landscape visibility and scenic attractiveness and correlation with ROS class mapping produced Scenic Integrity Objectives (SIOs) maps for all national forest system lands on the South Kaibab National Forest.

Scenic integrity is an expression of the "intactness" of landscape and how much deviation is present, and can also be considered as an expression of the gap between existing and desired conditions. The project area can largely be described as having "Moderate Scenic Integrity". This is a reflection of the presence of some direct human-caused deviations in the landscape (such as powerline right-of-ways and microwave towers on the mountain), and of years of indirect deviation from historic fire regimes, leading to much denser forested stands than were here historically, and less diversity (loss of meadow openings, aspens, understory species). Although the current day conifer forests are still perceived as being visually pleasing by many visitors, the resulting fuel loading and unnaturally high tree densities are setting the stage for dramatic changes to landscape character and scenic attractiveness from large-scale disturbance factors, such as insect outbreaks and wildfires. There has already been some recent beetle-kill evident in the western parts of the project area, particularly visible on the lower slopes of Bixler Mountain.

Approximately 7,500 acres of the Twin Project area has been treated with prescribed fire within the past decade. Although maintenance burning is needed to address building fuels, these areas are considered to be improving in scenic integrity, as tree densities and fuel loading are begin to resemble more historic conditions.

Landscape Character Goals and Scenic Integrity Objectives (SIO) for the project area have been defined in the Forest Plan and the Kaibab ROS/SMS Guidebook (2004). SIOs define the degrees of deviation in form, line, color, scale and texture that may occur at any given time, thus helping to define a transition strategy between the existing landscape character and scenic integrity, and the desired landscape character and integrity. SIOs overlay and cross Ecosystem Management Area boundaries. Because of the high scenic values and interest in the area surrounding Bill Williams Mountain, the area is classified as SIO 2 – in the highly visible and viewed areas, and SIO 3 – Moderate in the less visible or less viewed areas.

Table 7. Scenic Integrity Objective (SIO) acres in the Twin Prescribed Burn project area.

Scenic Integrity Objective (SIO)	Approximate Acres	General Setting Description/Desired Condition
SIO 2 – (High)	9583	High (appears unaltered). The valued landscape character appears intact. Deviations blend so well that the change is not evident to the casual observer by the end of the project activity. Projects usually completed within one year.
SIO 3 – (Moderate)	5036	Moderate (slightly altered). Noticeable deviations remain visually subordinate to the landscape character being viewed at the end of the project activity. Projects usually completed within two years.

Environmental Effects

Alternative 1 - No Action Alternative

Direct and Indirect Effects on Recreation Resources

Under the No Action alternative, there would be no immediate direct, indirect, or cumulative effects on the 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, 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. However, due to unnaturally high stand densities and fuel loadings, there would continue to be the potential for disturbance processes to affect the landscape negatively, such as insect outbreaks, diseases, and wildfires. Of great concern to maintaining high recreational values is a high potential for large, stand-replacing crown fires to occur in the project area. If a large stand-replacing crown fire swept through the area, it could completely destroy or seriously damage the numerous recreation developments and investments located in the area, and possibly even damage adjacent investments outside the project area. The loss of trees and vegetation and potential for severe erosion following a wildfire could seriously damage recreational settings in the Twin Project area, and the quality of life of locals and other national forest visitors who value forest recreational opportunities and facilities could be negatively affected for decades. Tourism may also be negatively affected if tourists decide not to visit the Williams area due to the negative effects a large wildfire could have on recreation resources.

Direct and Indirect Effects on Scenic Resources

Under the No Action alternative, there would be no immediate direct or indirect effect to the overall landscape character, scenic integrity, or other scenic resources and Forest Plan SIOs would be met in the short-term. However, current forest conditions are outside the natural range of historic variability, and that these conditions are not sustainable over time. Due to the presence of unnaturally high stand densities and fuel loadings, there is the potential for unnaturally large, stand-replacing wildfires to dramatically change the scenic attractiveness of the area, particularly the highly visible Bill Williams Mountain and Bixler Mountain. A large stand-replacing wildfire would be devastating to maintaining the existing high scenic attractiveness of the project area, and would negatively affect the chances of achieving the desired landscape character in the long-term. Effects of a large wildfire would likely be very long lasting, possibly many decades, until characteristic pine forests were once again re-established. The quality of life local residents currently experience related to living in a high mountain, ponderosa pine forest setting may also be negatively affected for many decades. The local economy may also be negatively affected in the long term if tourists decide not to visit the Williams area due to the long-lasting negative effects of a large wildfire.

Alternative 2 - Proposed Action

Direct and Indirect Effects on Recreation Resources

Under this alternative, it is expected that there will be some short-term direct and indirect effects to recreation settings. Direct effects of prescribed burning and fireline 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 activity slash, smoky conditions while people are visiting the area); however, these effects are expected to be very short in duration and intensity. The immediate effects following burning, including blackened ground, dead seedlings, scorched bark and needles, will persist for about a year until red needles fall, vegetation recovers and black fades. Although some visitors may prefer to not see any signs of fire in the forest, or recreate in recently burned areas, the effects of low and even some moderate intensity fires are beginning to be accepted by the public as an integral part of a healthy forest landscape.

Direct effects to recreation settings of mechanical treatments in safety zones and fireline preparation areas (up to 382 acres) would be a short-term, temporary change in ROS setting quality, which would persist one or more seasons until activity slash is treated and the treated area recovers to an “unaltered” or “undisturbed” appearance. Effects of mechanical treatments are expected to take longer (several seasons) to recover in the two semi-primitive ROS settings. Mitigation measures (p. 11) have been designed to insure that direct effects of project activities are short-term, and important recreation values are protected in the long-term. This alternative better provides for the long-term protection of recreational settings and facilities by improving stand conditions and reducing fuel loading. Maintaining healthy, green forests and reducing the risk of high-intensity stand-replacement type fires in the project area will have a positive effect on protecting and maintaining high quality recreation settings into the future. This alternative will provide for the treatment of fuels along the powerline right-of-way, particularly where it crosses the lower Benham Trail, which should provide a direct benefit to that recreational facility and trail experience.

Direct and Indirect Effects on Scenic Resources

Under this alternative, it is expected that there will be some short-term direct and indirect negative effects on scenic integrity in the project area from the proposed mechanical treatments. Evidence of management activities including fire control lines, stumps, activity slash, soil disturbance, and perhaps some painted trees, will be visible from some high sensitivity travel corridors and viewing locations immediately during and after implementation, until slash is burned, line restoration is completed, and a season or two of needlecast and understory vegetation recovery occurs. Residents and visitors who have been to the area will likely notice the change in tree densities in the fireline preparation areas. With employment of the mitigation measures, the immediate and short-term negative effects to scenic resources in the most sensitive areas would be minimized, and the Forest Plan SIO's for the area achieved within or very close to the prescribed timelines.

The effects of prescribed fires are expected to be beneficial, leading to long-term improvements in scenic integrity. Low-intensity fire and its effects are acknowledged as integral to the characteristic landscape. The forests in northern Arizona have evolved with and are dependent on periodic fires to maintain them. Smoke from prescribed fires can have a localized negative effect on actually viewing scenic vistas and features; however, these effects are typically very short-term, usually persisting less than a week. The immediate effects following burning, including blackened ground, dead seedlings, scorched bark and needles, will persist for about a year until red needles fall, vegetation recovers and black fades. Although some visitors may prefer to not see any signs of fire in the forest, the effects of low and even some moderate intensity fires are beginning to be accepted by the public as an integral part of a healthy forest landscape.

This alternative provides for gradual improvement of scenic integrity by reducing the potential for wildfire and associated indirect effects caused by wildfire suppression. It is expected to produce long-term benefits in scenic resources when compared to the No Action alternative. Improving and restoring more natural stand conditions and reducing fuel loading would contribute to the long-term protection and maintenance of scenic resources in the project area by reducing the risk of unnaturally large-scale, stand-replacing crown fires from occurring in the area.

Cumulative Effects on Recreation and Scenic Resources

The time period for the recreation and scenic resources cumulative effects analysis begins five years prior to implementation of the Twin Burn Project and ends three years after burning. Five years was chosen because it typically takes one to two years of drying to dispose (burn) of slash after thinning projects, and approximately two to three years for the visual effects of fireline preparation and prescribed burning to recover until they are generally unnoticeable to average visitors. The total time period for this analysis is 18 years (5 years prior, 10 years implementation, and 3 years after implementation).

The area chosen for the cumulative effects analysis of this project extends approximately 5 to 6 miles in each direction from Bill Williams Mountain. This area was chosen because the project area is part of the larger Bill Williams Mountain viewshed, and the mountain is an important feature and focal point for high levels of recreational use.

Current ongoing and recently implemented projects in this analysis area and surrounding the Twin Project area include Clover High, West Beacon, Williams High Risk, Williams Campground Bark Beetle Vegetation Treatments, and Beacon Central. Additionally, four projects are currently being

planned in the analysis area. They include the City Project, Bill Williams Mountain Fuels, McCracken, and Dogtown Fuels projects. Because of the recent increased emphasis for reducing hazardous fuels in the urban interface, it is estimated that much of the area extending five to six miles in each direction from Bill Williams Mountain would be in the physical state of being mechanically treated, awaiting final slash treatments and prescribed burning, or in a post treatment recovery phase.

Since mechanical treatments are limited to fireline and safety zone preparation areas, which amount to a small percentage of the overall project area the Twin Project will contribute minimally to the cumulative effects of mechanical treatments in the analysis area.

Based on recent fuel reduction targets, it is estimated that up to 5,000 acres could be burned each year in the cumulative effects analysis area. Because visual effects of prescribed burning can last up to three years, approximately 15,000 acres, or 20 - 25% of the analysis area, could be in the physical state of being recently burned.

Recreation Resources

The cumulative effect of the proposed action when combined with past, concurrent and planned actions would be that scattered over 20 to 25% of the analysis area there would be immediate, short-term negative effects to recreation facilities, settings, and opportunities. It may be difficult for recreationists to find untreated areas in the vicinity of Bill Williams Mountain, if that is their preference. However, in the long-term the cumulative effects of prescribed burning and mechanical treatments are considered beneficial, providing for better long-term protection of recreation settings and opportunities.

Scenic Resources

Scenery and scenic resources in the analysis area will be dominated by vegetation and fuels treatments over the next eighteen years, and this will affect landscape character and scenic integrity, most noticeable in foreground views. It may be difficult to fully achieve SIOs across the larger landscape until initial treatments and slash disposal is completed and some natural recovery has occurred. The cumulative effect of the proposed action when combined with past, concurrent and planned actions would be short-term negative effects to scenic resources, but better protection of scenic resources in the long term.

Environmental Justice

On February 11, 1994, President Clinton issued Executive Order 12898, *"Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*." This Executive Order was designed to focus the attention of federal agencies on the human health and environmental conditions in minority and low-income communities. It requires federal agencies to adopt strategies to address environmental justice concerns within the context of existing laws, including NEPA. The goal of Environmental Justice Analysis is not to shift risks among populations, but to identify potential disproportionately high and adverse effects, and to identify Alternatives that may mitigate these impacts.

There are large Hispanic and American Indian populations in the southwest. The Indian Tribes listed in Chapter 4 were consulted regarding this proposal and no concerns were expressed. Individual tribal members may use the area for the personal collection of traditional or medicinal plants. Low income groups use the area for the collection of fuelwood.

Alternative 1 – No Action

The No Action Alternative does not reduce the risk of high intensity, stand replacing wildfire. In the event of such a fire, lower income persons in the area may be adversely affected. A study commissioned by the University of Oregon's Center for Watershed and Community Health (2001), highlights the fact that wildfire has a disproportionately greater effect on low-income households.

Although all communities, wealthy and poor, suffer direct economic consequences when wildfire destroys homes, poorer people are more likely to lose all of their assets: buildings, possessions, livestock, and vehicles. Wealthier families usually have insurance to replace lost possessions, and financial assets, such as bank accounts and investments that may not be affected by fire. Wildfires can disrupt normal commercial activity by causing homes to be evacuated and work places to close. The need for short-term lodging or long-term alternative housing, as well as the temporary loss of work, can overwhelm low-income families. Fires can also curtail the supply of native plants, and building supplies that sustain many traditional and indigenous communities.

Alternative 2 – Proposed Action

The Proposed Action would reduce the risk of high intensity stand replacing wildfire. The fuels treatments are based upon the resource conditions and capabilities; and are applied regardless of the ethnicity or income level of local residents.

Chapter 4 - Consultation and Coordination

The Forest Service consulted the following individuals, Federal, state and local agencies, tribes and non-Forest Service persons during the development of this environmental assessment:

ID Team Members:

Ariel Leonard, Team Leader	NEPA Planner
Vic Morfin	Fuels Program Manager
Mark Herron	Silviculturist
Robin Rose	Recreation and Wilderness Planner
Lauren Johnson	Soils and Watershed
Chuck Nelson	Wildlife Biologist
Neil Weintraub	Archeologist

Support:

Barb McCurry	NEPA Planner
Tim McGann	GIS/ Data Administrator
Jackie Denk	Fire Information Officer
John Brink	Technical Services Branch Leader
Susan Logan	Mail/File Clerk
Bonnie Benettsen	Wildlife Biologist

Federal, State, and Local Agencies:

US Fish & Wildlife Service

Arizona Game and Fish Department

Arizona Department of Agriculture

Arizona Department of Environmental Quality

Williams Chamber of Commerce

The City of Williams

Indian Tribes

Hopi Tribe

Navajo Nation

Hualapai Tribe

Havasupai Tribe

Yavapai-Prescott Indian Tribe

Pueblo of Zuni

Others:

Jim Unmacht	Arizona Antelope Foundation
Erik Ryberg	Center for Biological Diversity
James Benham	
Virginia Cole	
John and Ginger Fareio	
Marcia Hagen	
Carol and H.D. Hale	
Linda Marciano	
Robert Nelita	
Harry Robertson	
Greg and Penny Stroud	
Jeff and Laura Woolsey	

Literature Cited

Beier, P. and J. E. Drennan. 1997. Forest structure and prey abundance in foraging areas of northern goshawks. Ecological Applications 7:564-571.

Brauer, Michael. 1999. Health impacts of biomass air pollution. In: Health guidelines for vegetation fire events: background papers. World Health Organization. 69 p. [from p.32 PMS 420-2 NFES 1279]

Boussard, L, M.E Lee., A.J. Stevens. 2002. Kaibab National Forest User Study Final Report. School of Forestry, Northern Arizona University. 10 p.

Brown, R.L. 1995. Tassel-eared squirrel population and habitat dynamics in northern Arizona. Arizona Game and Fish Department. 27 p.

Center for Watershed and Community Health. 2001. Wildfire and Poverty: An Overview of the Interactions Among Wildfires, Fire-Related Programs, and Poverty in the Western States. Portland State University, Portland, OR.

Covington, W.W., and M.M. Moore. 1994. Postsettlement changes in natural fire regimes and forest structure: ecological restoration of old-growth ponderosa pine forests. Journal of Forestry 92: 39-47.

Crisp, D., personal communication, 2001 and 2003. Botanist, Coconino National Forest, Flagstaff, Arizona.

Dodd, N.L. 2003. Landscape-scale habitat relationships to tassel-eared squirrel population dynamics in north-central Arizona. Arizona Game and Fish Technical Bulletin No. 6, 29 p.

Hoffman, R.W., H.G. Shaw, M.A. Rumble, B.F. Wakeling, C.M. Mollohan, S.D. Schemnitz, R. Engel-Wilson, and D.A. Hengel. 1993. Management guidelines for Merriam's wild turkeys. Colorado Div. Wildlife Report No. 18. DOW-R-D-18-93, Fort Collins. 24 p.

Lee, R. 1986. Report to Western States and Provinces Elk Workshop. Pages 61-64 in Proceedings of Western States and Provinces Elk Workshop. Oregon Dept. of Fish and Wildlife, Coos Bay, Oregon.

Mannan, R.W. and C. W. Boal. 1993. Diets of northern goshawks in ponderosa pine forest, northern Arizona. University of Arizona Final Report. 26 p.

Mast, J.N., P.Z. Fulé, M.M. Moore, W.W. Covington, and A.E.M. Waltz. 1999. Restoration of presettlement age structure on an Arizona ponderosa pine forest. Ecological Applications 9(1): 228-239.

National Wildfire Coordinating Group. 1997. Photo Series for Quantifying Forest Residuesin the Southwestern Region. PMS-822, NFES 1395.

Rabe, M. J., T. E. Morrell, H. Green, J.C. DeBos, Jr., and C. R. Miller. 1998. Characteristics of ponderosa pine snag Roosts used by reproductive bats in northern Arizona. Journal of Wildlife management 62:612-621.

Reinhardt, E.D. and N.L. Crookston. 2003. The Fire and Fuels Extension to the Forest Vegetation Simulator. RMRS-GTR-116. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 209 p.

Reynolds, R.T., R.T. Graham, R.M. Hildegard. 1992. Management recommendations for the northern goshawk in the southwestern United States. Gen. Tech. Rep. RM-217, Ft. Collins, CO: USDA-Forest Service, Rocky Mountain Forest and Range Experiment Station. 90 p.

Reynolds, R.T. 2004. Is the northern goshawk an old growth forest specialist or a habitat generalist? Unpublished Report, Rocky Mountain Research Station, Fort Collins, CO. 31 p.

Rothermel, R.C. 1972. A mathematical model for predicting fire spread in wildland fuels. Research paper. INT-115. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 40 p.

Sackett, S.S. 1980. Reducing natural ponderosa pine furls using prescribed fire: Two case studies. USDA Forest Service Research Note RM-392. 6 p.

USDA Forest Service 1997. Williams / Chalender Districts Wildland Urban Interface Fire Risk Assessment. Unpublished Report, February 7, 1997. 15 p.

USDA Forest Service 1998 Region 3, 1998 Protocols for Implementation and Effectiveness Monitoring: Mexican Spotted Owl Microhabitat, based upon the Microhabitat Monitoring Protocol for the Mexican Spotted Owl (U.S. Department of Agriculture; April 24, 1998.

USDA Forest Service. 1998. Noxious Weeds Strategic Plan Working Guidelines (Coconino, Kaibab, Prescott National Forests, 1998)

USDA Forest Service.1999. FSM 2670.5 (19) Threatened, Endangered and Sensitive Plants and Animals species list, Southwestern Region,dated July 21, 1999.

USDA Forest Service. 2000. FSM 5100, Chapter 5140, R3 Supplement No. 5100-2000-2, 12/22/2000).

USDA Forest Service, 2001. National Visitor Use Monitoring (NVUM) Results, Region 3, Kaibab NF. .Final Pub 28 Aug 2001. 21 p.

USDA Forest Service.2002. South Kaibab National Forest Recreation Desired Future Condition – Existing Condition Draft Report.. 44 pages.

USDA Forest Service 2003. Management Indicator Species for the Kaibab National Forest Version 1.2, October 2003. Prepared by Bill Noble. 140 p.

USDA Forest Service 2004. Kaibab National Forest Recreation Opportunity Spectrum and Scenery Management System Guidebook (KNF ROS/SMS Guidebook). Kaibab NF. 52 p.

USDA Forest Service. 2004. Kaibab National Forest Land Management Plan, as amended. USDA Forest Service, Albuquerque, NM.

USDA Forest Service. 2004. Kaibab National Forest Recreation Opportunity Spectrum and Scenery Management System Guidebook (KNF ROS/SMS Guidebook). 52 pp.

USDA Forest Service. 2005. Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds. Coconino, Kaibab, and Prescott National Forests within Coconino, Gila, Mojave, and Yavapai Counties, Arizona.

USDA Forest Service and Arizona Game and Fish Department. 1990. Arizona Wildlife and Fisheries Comprehensive Plan, signed November 5, 1990. 22 p.

USDA Forest Service and AZ State Historic Preservation Office. 2003. Hazardous Fuels Reduction Programmatic Memorandum of Agreement.

USDI and USDA. 2001. Ten-year comprehensive strategy: A collaborative approach for reducing wildland fire risks to communities and the environment. Available from http://www.fireplan.gov/reports/7-19-en.pdf (Accessed May 10,2005).

USDI U.S. Fish and Wildlife Service.2003. Mexican spotted owl survey protocol.

USDI U.S. Fish and Wildlife Service and USDA Forest Service. 1999. Arizona Bugbane Conservation Agreement. USDI 1999

Glossary

BASAL AREA the cross section area of tree stems in square feet commonly measured at breast height (4.5' above ground) and inclusive of bark.
BENTONITE material composed of clays used for improving the water holding capacity of earthen water tanks.
CHAIN a unit of horizontal measurement (66 feet) used by foresters and U.S. Government Land surveys. Square chains are easily converted to acres by dividing by 10.
CROWN the top or upper portion of a tree including limbs, branches and foliage.
DBH diameter at breast height, the standard height (4 ½ feet) for measuring diameter of most tree species.
DOZER LINE fireline constructed with the front blade of a bulldozer.
DOZER PILING forest debris or slash mechanically stacked or piled with a bulldozer.
DUFF humus layer of decaying plant material between the surface litter and mineral soil.
FIRELINE a line free of fuels, used to contain a fire or protect features.
FUEL any combustible material.
FUELBREAK an area or strip of land with little to no fuels, live or dead.
FUELLOAD the weight of combustible material per area (i.e. ton/acre).
HERITAGE RESOURCE the remains of sites, structures, or objects used by humans more than 50 years ago, historic or prehistoric.
JACKPOT a concentration of fuels that will burn hotter than the surrounding area.
LADDER FUELS fuels that can carry fire from the ground surface up into the crowns of trees, includes low tree branches, shrubs, small or dead trees, and witches' brooms.
LITTER organic material including grasses, needles, twigs, and leaves on the soils surface.
MAINTENANCE BURNS follow-up burns intended to consume dead and down fuels created by previous burns.
PRESCRIBED FIRE management-ignited fire burning under specific weather, fuel, and fire behavior conditions to meet site-specific resource management objectives.
PRESCRIPTION a set of measurable criteria that define conditions or parameters under which thinnings are to take place or fires are allowed to burn.
PRETREATMENT activities done prior to treatment, usually involving the removal or rearrangement of fuels (thinning and piling) so that treatments are more effective.
POLE-SIZED trees in the 5 to 12-inch diameter-class.
PRUNING cutting and removal of live and dead branches from live standing trees.
SEEDLINGS SEEDLING a tree, usually less than 2 inches diameter at breast height, that has grown from a seed rather than from a sprout.
SAPLINGS young trees between 2 and 5 inches in diameter.
SLASH debris including logs, branches, and stumps left after thinning or logging operations.
SNAG a standing dead tree.
SPOT FIRE or SPOTTING smaller fires that start from blowing embers in front of or adjacent to an existing fire.
THINNING cutting and removal of trees to reduce stand density, usually specified in a management prescription (i.e. trees less than 9 inches dbh).
UNDERBURN a surface fire that consumes ground fuels but does not kill overstory trees.
WITCHES' BROOM abnormal growth of dense shoots and twigs caused by mistletoe infections in trees, named for its resemblance to an oddly shaped broom.
YELLOW BARK or YELLOW PINE a mature ponderosa pine, generally older than 130 years, with greater than 40% of its bark on the trunk a light brown or tan, and "plating" at the tree's base.

Appendix 1. Species that would not have habitat or population trends affected by any of the alternatives.

Common Name	Scientific Name	Status	Rationale
Amphibians			
Lowland Leopard Frog	*Rana yavapaiensis*	Sensitive	Range does not overlap – occurs below 5,500 feet elevation and is primarily found below 3,000 feet.
Northern Leopard frog	*Rana pipiens*	Sensitive	No impacts to habitat- occurs in permanent fresh water ponds or streams that would not be affected by either alternative. Tanks adjacent to the project area were surveyed in 1992 and 1993 and no frogs were found in those tanks.
Birds			
American Peregrine Falcon	*Falco peregrinus anatum*	Sensitive	No impacts to habitat or population trends-uses cliffs for nesting and forages over a wide area and on a variety of birds.
Bendire's Thrasher	*Toxostoma bendirei*	FWS Bird of Conservation Concern (BCC)	No impacts to habitat or population trends – uses sagebrush and scattered junipers; no sagebrush occurs in project area and junipers would not be affected by low intensity fire.
Black Swift	*Cypseloides niger*	BCC	No impacts to habitat or population trends – forages over forests and open areas and breeds in cliffs near waterfalls that do not occur within or near the project area.
California Condor	*Gymnogyps californianus*	Endangered, Experimental/ Nonessential (Northern Arizona)	Range does not overlap – this experimental population occurs within the Vermillion Cliffs, Paria Plateau, and areas surrounding the Grand Canyon.
Chihuahua savannah sparrow	*Passwerculus sandwichensis rufofuscus*	Sensitive	No impacts to habitat or population trends-uses grasslands of which only 23 acres are identified within the project area.
Common Black Hawk	*Buteogallus anthracinus*	Sensitive	No potential habitat - occurs in lowland forest, especially cottonwoods, along rivers and streams.
Crissal Thrasher	*Toxostoma crissale*	BCC	No potential habitat – occurs in chaparral habitat.
Gunnison Sage Grouse	*Centrocercus minimus*	Candidate; Sensitive; BCC	Range does not overlap – now restricted to western Colorado and eastern Utah.

Common Name	Scientific Name	Status	Rationale
Gray Flycatcher	*Empidonax wrightii*	AZ Partners in Flight Priority Bird Species of pinyon-juniper habitat	No impacts to habitat or population trends – uses ponderosa pine, pinyon pine, and juniper trees that would not be affected by low intensity prescribed fire.
Gray Vireo	*Vireo vicinior*	BCC; AZ Partners in Flight Priority Bird Species of pinyon-juniper habitat	No impacts to habitat or population trends – uses shrubby vegetation and junipers that would not be affected by low intensity prescribed fire.
Juniper Titmouse	*Baeolophus griseus*	AZ Partners in Flight Priority Bird Species of pinyon-juniper habitat	No impacts to habitat or population trends – uses tall, moderately dense junipers that would not be affected by low intensity prescribed fire.
Lucy's Warbler	*Vermivora luciae*	MIS of late seral, low elevation (<7,000 feet) riparian habitat	No potential habitat – occurs in riparian cottonwood and willow habitat in mountain foothills and desert riparian mesquite.
Mountain Plover	*Charadrius montanus*	BCC	Breeding and wintering ranges do not overlap – breeding range borders eastern AZ; winter range includes southern AZ.
Purple Martin	*Progne subis Linnaeus*	AZ Partners in Flight Priority Bird Species of pine habitat	No impacts to habitat or population trends – uses snags that would not be affected by low intensity prescribed fire.
Sage Sparrow	*Amphispiza belli*	BCC	No potential habitat – occurs in sagebrush and associated habitats.
Short-Eared Owl	*Asio flammeus*	BCC	No potential habitat - occurs in fresh or saltwater marshes, bogs, dunes, or tundra.
Snowy Plover	*Charadrius alexandrinus*	BCC	No impacts to habitat or population trends - does not breed or winter within project area, possible transient on ponds.
Solitary Sandpiper	*Tringa solitaria*	BCC	Breeding and wintering ranges do not overlap – does not breed or winter within Arizona.
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	No potential habitat – occurs along rivers, streams, and other wetlands with dense riparian vegetation.
Sprague's Pipit	*Anthus spragueii*	BCC	Breeding and wintering ranges do not overlap – does not breed in Arizona; winters in southern Arizona.

Common Name	Scientific Name	Status	Rationale
Yellow-Billed Cuckoo	*Coccyzus americanus*	Candidate, BCC	No potential habitat – occurs in large blocks of riparian woodlands (cottonwood, willow, or tamarisk).
Yellow Breasted Chat	*Icteria virens*	MIS of late seral, low elevation (<7,000 feet) riparian habitat	No potential habitat – occurs in riparian associated dense shrubby habitat.
Yuma Rufous-Crowned Sparrow	*Aimophila ruficeps rupicola*	Sensitive	No impacts to habitat or population trends – uses pinyon pine and juniper trees that would not be affected by low intensity prescribed fire, because of lack of grasses and shrubs that would help carry fire in the vicinity of these trees.
Fish			
Apache (Arizona) Trout	*Oncorhynchus apache*	Threatened	Range does not overlap and no potential habitat – restricted to perennial streams of upper Salt, Blue, and Little Colorado drainages and introduced to North Canyon and Grant Creek.
Little Colorado Spinedace	*Lepidomeda vittata*	Threatened	Range does not overlap and no potential habitat – occurs in north-flowing tributaries of the Little Colorado River with slow to moderate water currents.
Spikedace	*Meda fulgida*	Threatened, Critical Habitat	No potential habitat – occurs in moderate to large perennial streams with moderate to swift water velocities. No effects to Critical Habitat Complex 1 (Verde River) owing to the large distance (approximately 25 miles) of the Complex to the project area.
Invertebrates			
A Tiger Beetle	*Amblycheila picolominii*	Sensitive	No impacts to habitat-species is found on bare rock, talus, or scree slopes.
Aquatic Macroinvertebrates	*Several species – Mayflies, Stoneflies, Cadisflies*	MIS of late seral riparian habitats	No impacts to habitat or population trends – represented habitat of healthy, aerated streams does not exist within the project area; populations of these species do not likely exist within the project area, owing to the lack of stream habitat.
Arizona Giant Sand Treader Cricket	*Daihinibaenetes arizonensis*	Sensitive	Not likely to occur in the project area – only two records exist from Apache County in high desert plateau.
Arizona Snaketail	*Ophiogomphus arizonicus*	Sensitive	No potential habitat – occurs along the sides of perennial streams.

Common Name	Scientific Name	Status	Rationale
Aryxna Giant Skipper	*Agathymus aryxna*	Sensitive	No potential habitat and host range does not overlap – occurs in southern Arizona canyons with its host plant, *Agave palmer.i*
Freeman's Agave Borer	*Agathymus baueri freemani*	Sensitive	No potential habitat and host range does not overlap – occurs in south central Arizona canyons with its host plant, *Agave chrysantha.*
Neumogen's Giant Skipper	*Agathymus neumoegeni*	Sensitive	No likely habitat – uses dry, open woodlands or shrublands with *Agave parryi.*
Obsolete Viceroy Butterfly	*Limenitis archippus obsoleta*	Sensitive	No potential habitat – occurs in riparian canyons and desert arroyos.
Mammals			
Black-Footed Ferret	*Mustela nigripes*	Endangered	No potential habitat – one female ferret and her litter are estimated to require approximately 598 acres of Gunnison's prairie dog habitat; no Gunnison's prairie dog towns exist within the project area.
Cactus Mouse	*Peromyscus eremicus papagensis*	Sensitive	No impacts to habitat or population trends – occurs on bare rock/talus/scree substrates in oak woodland that would incur any effect from a low intensity prescribed fire.
Desert Bighorn Sheep	*Ovis canadensis mexicana*	Sensitive	Current range does not overlap – occurs within the Grand Canyon area and the southern portion of the state.
Gunnison's prairie dog	*Cynomys gunnisoni*	Local concern	No impacts to habitat or population trends-uses grasslands of which only 23 acres are identified within the project area.
Mexican Gray Wolf	*Canis lupus baileyi*	Endangered	Range does not overlap – formally occurred in SE AZ and possibly central Arizona in Upper Sonoran woodlands and grasslands; an experimental/non-essential population has been introduced to the Blue Primitive Area of Greenlee and Apache counties.
Pronghorn antelope	*Antilocapra americana*	MIS	No impacts to habitat or population trends-uses grasslands of which only 23 acres are identified within the project area.
Western Red Bat	*Lasiurus blossevillii*	Local Concern	No potential habitat - occurs in riparian habitat with cottonwoods, oaks, and sycamores.
Wupatki Arizona Pocket Mouse	*Perognathus amplus cineris*	Sensitive	No potential habitat – occurs in desert scrub habitats.

Common Name	Scientific Name	Status	Rationale
Reptiles			
Arizona Night Lizard	*Xantusia vigilis arizonae*	Sensitive	No potential habitat – occurs in granite outcrops.
Narrow-Headed Garter Snake	*Thanmophis rufipunctatus*	Sensitive	No potential habitat – occurs in or next to perennial rocky streams.
Snails			
Brown Springsnail	*Pyrgulopsis sola*	Sensitive	Range not likely to overlap – found in the Lower Verde Watershed in Yavapai County; the *Pyrgulopsis* genus tends to be highly endemic.
Cumming's Mountainsnail	*Oreohelix yavapai cummingsi*	Sensitive	Range not likely to overlap – most records from New Mexico, northeast of Santa Fe; very rare in Arizona.
Desert Springsnail	*Pyrgulopsis deserta*	Sensitive	Range not likely to overlap – found in the Upper and Lower Virgin River watersheds in Mohave County, Arizona and Washington County, Utah; the *Pyrgulopsis* genus tends to be highly endemic.
Fossil Springsnail	*Pyrgulopsis simplex*	Sensitive	Range not likely to overlap – found in the Lower Verde Watershed in Yavapai and Gila counties; the *Pyrgulopsis* genus tends to be highly endemic.
Grand Wash Springsnail	*Pyrgulopsis bacchus*	Sensitive	Range not likely to overlap – found in the Grand Wash Watershed, Mohave County; the *Pyrgulopsis* genus tends to be highly endemic.
Kingman Springsnail	*Pyrgulopsis conica*	Sensitive	Range not likely to overlap – found in the Havasu-Mohave Lakes and Sacramento Wash watersheds in Mohave County; the *Pyrgulopsis* genus tends to be highly endemic.
Montezuma Well Springsnail	*Pyrgulopsis montezumensis*	Sensitive	No potential habitat and range not likely to overlap – occurs in perennial springs and spring brooks; benthic; found in the Upper Verde Watershed in Yavapai County; the *Pyrgulopsis* genus tends to be highly endemic.
Niobrara Ambersnail	*Oxyloma haydeni haydeni*	Sensitive	No potential habitat – occurs in perennial riverside springs with wetland vegetation.
Verde Rim Springsnail	*Pyrgulopsis glandulosa*	Sensitive	Range not likely to overlap – found in the Agua Fria Watershed in Yavapai County; the *Pyrgulopsis* genus tends to be highly endemic.