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Land and Resource Management Plan for the Kaibab National Forest

Coconino, Yavapai, and Mojave Counties, Arizona

Cover: collage of four images—Kanab Wilderness, Abert squirrel, Ponderosa pine, and aspen.

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Land and Resource Management Plan for the Kaibab National Forest

Coconino, Yavapai, and Mojave Counties, Arizona

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Copies of this plan and supporting material may be accessed at:*http://fs.usda.gov/goto/kaibab/plan_revision*

Administrative changes to this Plan were made after the Record of Decision was signed on 02/03/2014. These changes were made in accordance with the 2012 Planning Rule (36 CFR 219.13). Details of plan changes are listed starting on page *vi*.

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Administrative changes to this Plan were made May 2015 as the result of appeals filed and informal resolution agreement and in response to appeal resolution instructions provided by the Forest Service Chief's Reviewing Officer following administrative review. These changes to the Forest Plan highlight cave, karst, and hydrogeological resource management (p. 31, 57, 58, 70, 77, 189, 190) , clarify the relationship between grazing capability and suitability (p. 111, 112), and better explain the role of allotment management plans and annual operating instructions in making adjustments to livestock grazing using the adaptive management framework (p. 70).

Chapter 1. Introduction

Plan Area

The Kaibab National Forest (NF) is one of six national forests in Arizona. It covers 1.6 million acres, and is located in Coconino, Yavapai, and Mohave Counties. The Kaibab NF is broken into three geographically separate ranger districts: the North Kaibab Ranger District lies north of Grand Canyon National Park, the Tusayan Ranger District is south of Grand Canyon National Park, and the Williams Ranger District is southernmost, separated from the Tusayan Ranger District by private and Arizona State lands (Figure 1). The Kaibab NF shares boundaries with Grand Canyon National Park, the Prescott and Coconino NFs, the Bureau of Land Management (BLM) Arizona Strip District, the Navajo and Havasupai Indian Reservations, city of Williams, town of Tusayan, Camp Navajo (a National Guard training site), and private lands.

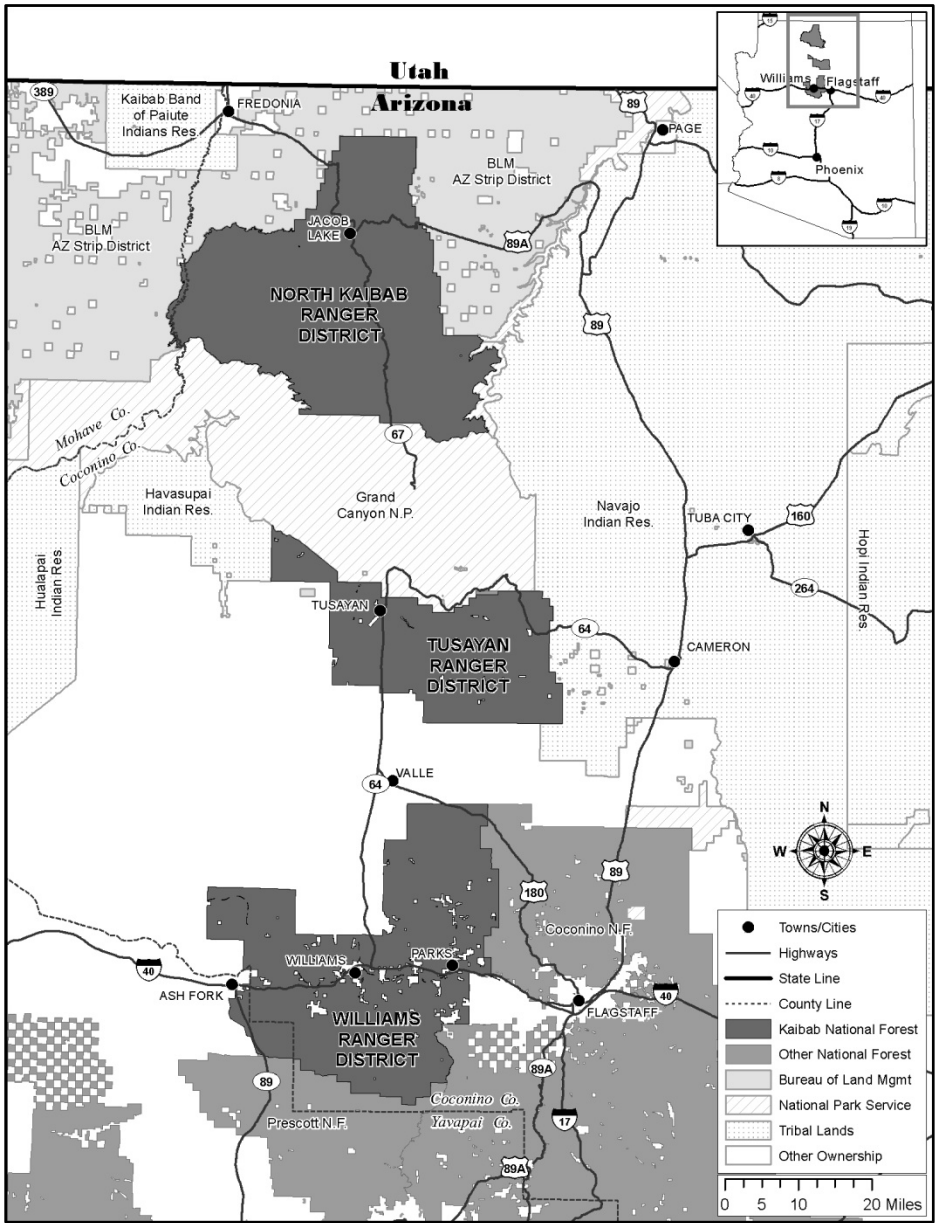

Figure 1. Vicinity map of the Kaibab National Forest

This plan[1] covers the National Forest System lands within the Kaibab NF boundary, with the exception of Sycamore Canyon Wilderness, which is covered by the "Coconino National Forest Land and Resource Management Plan." This plan provides guidance for all of the Kendrick Mountain Wilderness, including the portion within the boundaries of the Coconino NF.

Roles and Contributions of the Kaibab National Forest

The distinctive history and characteristics of the Kaibab NF frame the roles and contributions it provides to the local area, State, region, and Nation. From the high-elevation lands of the Kaibab Plateau on the North Kaibab Ranger District to the rolling hills and open country of the Tusayan Ranger District to the scattered cinder cones and canyons of the Williams Ranger District, the Kaibab NF includes wide variations in landscape, vegetation, and wildlife. As such, the Kaibab NF provides unique resources and recreation opportunities that attract a wide spectrum of forest users.

The diversity of wildlife found on the Kaibab NF provides enjoyment and aesthetic value for the photographer, bird watcher, nature lover, hiker, camper, and hunter. The Kaibab NF is home to large mammals including mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), bighorn sheep (*Ovis canadensis*), pronghorn (*Antilocapra americana*), mountain lion (*Puma concolor*), black bear (*Ursus americanus*), and many other species.

The Kaibab NF has a diversity of vegetation types due to the range of elevation and soil types. Pinyon-juniper woodlands cover 40 percent of the Kaibab NF and are found at lower elevations. As elevation increases, pinyon-juniper transitions to ponderosa pine forest, which covers 35 percent of the Kaibab NF. Other vegetation types include mixed conifer, grasslands, sagebrush shrublands, Gambel oak shrublands, and desert communities. Aspen, riparian, and wetland vegetation is present in small, yet important, areas.

The Kaibab NF lies mostly within Coconino County, which is the second largest county in the United States. Of the county's 18,000 square miles, only 13 percent is privately owned. Its population of 134,000 averages only about 7 people per square mile. Due to the small percentage of private land in the area, the Kaibab NF has long played an important role in providing for a variety of resources, uses, and activities including ranching, logging, forest product collection, hunting, and cultural events.

American Indian tribes and people in nearby communities have long-time connections to the Kaibab NF. It contains lands traditionally used by the Navajo, Hualapai, Kaibab Band of Paiute, Hopi, Havasupai, Yavapai, and Zuni people. The communities around the Kaibab NF were later settled by Mormons, Spanish explorers, cattlemen, and loggers. This history continues to influence the culture today as western rural lifestyles and traditional uses are important to the local communities.

Recreationists engage in a variety of activities such as hiking, camping, sightseeing, and driving/riding for pleasure. Tourism has played an increased role over the last 20 years. The proximity of the Kaibab NF to Grand Canyon National Park and historic Route 66 attracts visitors

[1] Note: terms defined in the glossary and are underlined text throughout the plan. These terms are hyperlinked to the glossary in electronic versions of the plan.

from across the Nation and throughout the world. Tourism-related activities contribute to local economic development and opportunities. Many area residents have jobs or businesses dependent on forest resources such as ranching, sandstone quarrying, wood harvesting, and outfitter-guiding.

Summary of the Analysis of the Management Situation

The management situation was analyzed in the 2009 Comprehensive Evaluation Report (CER; USDA 2009) and supplement to the CER (USDA 2010). The CER evaluated the need for change in light of how management under the 1988 plan (as amended) was affecting the conditions and trends related to sustainability. The CER integrated key findings from the ecological and the socio-economic sustainability reports. This integration displayed the key management needs for change, potential activities, and socioeconomic ecological interactions. These were used to identify where the conditions and trends indicated a potential need for change in the plan. The supplement to the CER contains additional analysis and information about projections of demand, benchmarks, and species considerations. Together, these documents meet the content requirements of the analysis of the management situation (AMS). These documents are available upon request and can be found on the Kaibab NF Web site at: http://fs.usda.gov/goto/kaibab/plan_revision.

The CER/AMS and subsequent management reviews considered this information along with the Forest Service mission, Forest role and contributions, and anticipated demands. They identified four areas where there were priority needs for change in program direction. These are to:

- Modify forest structure and species composition to restore or maintain sustainability and restore historic fire regimes.
- Protect and regenerate aspen to ensure long-term healthy aspen populations.
- Protect and restore natural waters and wetlands to ensure healthy riparian communities.
- Restore grasslands by reducing tree encroachment and restoring fire.

The most apparent need for change is to reduce the risk of uncharacteristic fires and restore the structure, species composition, and function of forested ecosystems. This emerged as the highest need for change in the ecological sustainability report and as a very high need in the socio-economic sustainability analysis. The concordant socioeconomic and ecological benefits of restoring forest structure include providing quality wildlife habitat, improving scenic integrity, providing for commercial and personal use wood products, protecting cultural resources, protecting against undesired fire effects, improving public and firefighter safety, increasing understory diversity, and improving soil condition.

Restoring aspen also emerged as a high priority. Aspen is an important species because of its contribution to local ecological diversity and its high social and economic value associated with scenery and tourism. Aspen has declined in areas across the West due to the combined effects of ungulate browsing, insects, disease, severe weather events, and lack of fire disturbance. Aspen decline has been of particular concern on the Williams Ranger District.

Protecting natural waters came forward as an important need for change. Natural waters in arid landscapes are centers of high biological diversity. About half of the natural springs and other waters on the Kaibab NF are currently departed from reference conditions. Protection and

restoration of these rare resources can be accomplished through actions such as controlling invasive species, maintaining or removing constructed modifications, fencing out large ungulates, and improving hydrologic function by reducing tree densities in adjacent vegetation types. Besides ecological values, natural water bodies are associated with high social and economic values such as bird watching and traditional cultural uses.

Grasslands are much less abundant than they were historically, which reduces the amount of available habitat for grassland-associated species. The subalpine/montane grasslands on the North Kaibab Ranger District tend to be long and narrow; as a result, they are at a higher risk of loss as trees encroach from the edges and the openings close more quickly. There is a need to develop desired conditions and set objectives for grassland ecosystems on the Kaibab NF, which are lacking in the original forest plan.

This plan focuses on the identified needs for change stated above. Over time, new information and changing conditions will emerge that call for changes in management. As these needs are identified, adaptive planning will be used to incorporate new information and amend the plan as needed.

Plan Purpose and Framework

The land and resource management plan (hereafter referred to as the plan) guides the Kaibab NF in fulfilling its stewardship responsibilities to best meet the needs of the American people for the present and into the future. The plan provides a framework to promote ecological integrity and guide management on the Kaibab NF so that it is ecologically sustainable and contributes to social and economic sustainability. This plan provides Forest-specific guidance and information for project and activity decision making over the plan period, which is generally considered to be 10 to 15 years. It is strategic in nature and does not specifically authorize or prescribe any specific projects or activities.

Plan Development

The National Forest Management Act directs that forest plans be revised on a 10- to 15-year cycle. Twenty-five years have passed since the regional forester approved the original Kaibab forest plan on April 15, 1988; this plan has been amended 10 times since that date. The last 25 years have provided new scientific information and understanding and changes in economic, social, and ecological conditions. This has resulted in a shift in management emphasis from outputs to outcomes.

This forest plan revision process was conducted in accordance with 1982 Rule Provisions as provided for in the transition language of the 2012 Land and Resource Management Planning Rule (36 CFR 219.17(b)(3)). This plan revision was initiated prior to the availability of the 2012 Rule, and as a result, the responsible official has chosen to use the 2012 Rule's transition provisions to revise the plan.

The original plan was used as a basis for the revised plan, but some content was not retained because it reiterated existing law, regulation, and policy; did not reflect current scientific information; was outside of management control; or due to changed conditions on and around the Kaibab NF. Development of the revised plan was an iterative process utilizing best available scientific information, regional guidance, internal feedback, and collaboration with a wide variety of government agencies, tribes, non-governmental organizations, and publics. Comments

received during the formal 90-day public comment period in 2012 were used to further refine plan content and environmental analysis.

Plan Content

This plan includes "plan components" and "other content." Plan components are displayed in text boxes to distinguish them from other sections of the plan. Once approved, any substantive changes to plan components would require a plan amendment with appropriate analysis as required under the National Environmental Policy Act (NEPA). A change to "other content" may be made using an administrative correction process. Administrative corrections are used to make changes such as updates to data and maps, management approaches, and relevant background information, and to fix typographical errors. The public is notified of all administrative corrections of the plan.

Plan Components

Plan components (decisions) include: goals/desired conditions, objectives, standards, guidelines, suitability of uses, management areas (including designated areas), and monitoring. They were developed collaboratively with input from a variety of external and internal stakeholders with broad interdisciplinary representation. Plan components do not reiterate existing law, regulation, or policy. An interdisciplinary team refined the final form and organization of the plan to make it as understandable, useable, and integrated as possible.

Desired Conditions **(Goals)** describe the aspirational picture for the Kaibab NF. Goals, as required by the 1982 Planning Rule provisions, are articulated as "desired conditions" in this plan. They are the ecological and socioeconomic attributes toward which management of the land and resources of the plan area are directed. They are not commitments or final decisions approving projects or activities; rather, they guide the development of projects and activities. They have been written to contain enough specificity to allow for determining progress toward their achievement. Projects are designed to maintain or move toward desired conditions and to be consistent with the plan over the long term. In some cases, goals/desired conditions may only be achievable over hundreds of years.

Objectives describe how the Kaibab NF intends to move toward the desired conditions. Objectives are concise projections of measurable, time specific intended outcomes. Objectives have been established for the work considered most important to address the needs for change and achieve desired conditions. They also provide metrics for evaluating accomplishments.

Guidelines are technical design criteria or constraints on project and activity decision making that help to make progress toward desired conditions. A guideline allows for departure from its terms, so long as the intent of the guideline is met. Deviation from a guideline must be specified in the decision document with the supporting rationale. When deviation from a guideline does not meet the original intent, a plan amendment is required.

Standards are technical design constraints that must be followed when an action is being taken to make progress toward desired conditions. Standards differ from guidelines in that standards do not allow for any deviation without a plan amendment.

Management Areas are delineated areas with a common set of plan components that differ from the general Forest. Management Areas are established to meet specific management needs.

Designated Areas are a special type of management area that are established by Congress or other administrative processes of the Federal executive branch because of unique or special characteristics. Examples of statutorily designated areas are national heritage areas, national recreation areas, national scenic trails, wild and scenic rivers, wilderness areas, and wilderness study areas. Examples of administratively designated areas are experimental forests, research natural areas, scenic byways, botanical areas, and significant caves.

Suitability of National Forest System **(**NFS) lands are identified as "suitable" for various uses. An area may be identified as suitable or not suitable for certain uses, depending on its compatibility with desired conditions and objectives for the area. This plan addresses suitability for timber, grazing, recreation, minerals, and energy resource activities.

Monitoring is the part of the adaptive management strategy used to determine the degree to which on-the-ground management is maintaining or making progress toward desired conditions. The monitoring plan includes questions and performance measures designed to evaluate implementation and effectiveness, and inform adaptive management.

Other Content

The "other content" in this plan includes background information, existing conditions, management approaches, and contextual information. Management approaches are not plan decisions, but they help clarify how plan direction may be applied. Management approaches include information and guidance for projects and activity decision making to help achieve desired conditions and objectives. Management approaches describe priorities, considerations, and strategies for achieving desired conditions and articulate the strategies needed to effectively make progress toward desired conditions within the context of the operating environment of the plan.

Plan Concepts

All lands is the concept that ecosystems transcend land ownership boundaries, thus, effective land and resource management requires cooperation and collaboration among the Forest Service, other land managing agencies, tribes, and private landowners. This plan was developed using an approach whereby plan components were developed considering the greater landscape and the Kaibab NF's ecological, social, and economic role.

Sustainability is meeting the needs of the present generation without compromising the ability of future generations to meet their needs. Sustainability is composed of desirable social, economic, and ecological conditions or trends interacting at varying spatial and temporal scales, embodying the principles of multiple use and sustained yield (FSM 2020.5).

Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedback (FSM 2020.5).

Scale. Desired conditions are described at multiple scales where appropriate. Descriptions at various scales are sometimes necessary to provide adequate detail and guidance for the design of future projects and activities that will help achieve the desired conditions over time. The three scales used in this plan are: fine scale, mid-scale, and landscape scale.

Fine scale is an area10 acres or less in size. In forested ecosystems, it is a scale at which the distribution of individual trees (single, grouped, or aggregates of groups) is described. Fine-scale desired conditions provide the view that can be observed standing in one location on the ground. Fine-scale desired conditions typically contain greater variability, which is desirable for providing heterogeneity at smaller spatial scales.

Mid-scale desired conditions are composed of assemblages of fine-scale units and have descriptions that would be averaged across areas of 100- to 1,000-acre units.

Landscape scale is an assemblage of 10 or more mid-scale units, typically totaling more than 10,000 acres, composed of variable elevations, slopes, aspects, soils, plant associations, and disturbance processes. Landscape scale desired conditions provide the big picture overview with resolution that would, for example, be observable from an airplane or from a zoomed out Google Earth view. The landscape scale is also an appropriate scale for describing less common components that would not necessarily occur on every mid-scale unit within the landscape.

Potential natural vegetation is the vegetation that would occur in the presence of natural disturbance processes such as frequent fire return intervals. In some areas, there is a difference between the existing vegetation type and the potential vegetation type, such as where historic grasslands are currently encroached by trees. The potential natural vegetation, not the existing vegetation, determines which desired conditions apply.

Vegetation structure includes both the vertical and horizontal dimensions. Horizontal structure may refer to patterns of trees or groups of trees and openings, as well as tree size and tree density. Vertical structure may refer to the layers, appearance, and composition of vegetation between the ground and the top of the tallest vegetation and may include grasses, forbs, shrubs, and trees.

Natural variability references past conditions and processes that provide important context and guidance relevant to the environments and habitats in which native species evolved. Disturbance driven spatial and temporal variability is vital to ecological systems. Biologically appropriate disturbances provide for heterogeneous conditions and subsequent diversity. Conversely, “uncharacteristic disturbance” such as high-intensity fire in plant communities that historically had a frequent low intensity fire regime can have the effect of reducing diversity, increasing homogeneity, and resulting in states that may be permanently altered.

Ranges of values presented in desired conditions reflect either natural or desired variation in the composition and structure within a community or resource area. Desired conditions may or may not be the same as historic conditions and may have wide ranges due to spatial variability in soils, elevation, aspect, or social values. Where desired conditions specify a range of values, the full spectrum of values within that range is desirable, although the desirable distribution of values within that range may vary depending on the resource. It may also be desirable to manage for desired conditions at the upper or lower end of a range in a particular area, such as lower vegetation density in the wildland-urban interface (WUI) to achieve the desired fire behavior within proximity

of private property and human occupancy. Higher densities may be desired in other areas to meet habitat requirements for specific species.

Integration recognizes and identifies key relationships between various plan resources and activities. Plan components are integrated to address a variety of ecological and human needs. For example, desired conditions for ponderosa pine incorporate habitat needs for a variety of species, as well as the scenic components that recreationists desire. Interrelationships between parts of the plan are identified with crosswalks to show their systematic nature. In electronic versions of the plan, these crosswalks are hyperlinked (indicated by italicized text) to allow users to be easily redirected to the other relevant sections of the plan.

Adaptive management is a system of management practices based on clearly identified intended outcomes and monitoring to determine if management actions are meeting those outcomes. If needed, it facilitates management changes that will best ensure that those outcomes are met or re-evaluated. Adaptive management stems from the recognition that knowledge about natural resource systems is sometimes uncertain (36 CFR 220.3), particularly for dynamic issues such as climate change, invasive species, and disturbances that are not easily predicted.

Climate change is addressed throughout this plan, indirectly through desired conditions in the form of functional ecosystems and resilient landscapes, and directly in management approaches and the monitoring plan where appropriate. Appendix D provides a more detailed explanation of the strategy the Kaibab NF is using to address climate change.

Plan Organization

Chapter 1 – Introduction briefly describes the planning area, the analysis of the management situation, purpose of this plan, plan components, how these components are organized within the plan, project consistency with the plan, and how the plan is implemented through project-level planning.

Chapter 2 – Forestwide Desired Conditions and Strategies includes forestwide desired conditions (goals), objectives, standards, and guidelines and is split into two sections: “Forest Resources” and “Forest Uses, Goods, and Services” (activities). Standards and guidelines are typically located in the relevant activity section of the plan, but when standards or guidelines pertain to multiple activities, they are located in the applicable resource section.

Chapter 3 – Management Areas contains the plan components applicable to specific areas that call for site-specific management. The management areas chapter is divided into two sections: “Designated Areas” and “Management Areas” (MAs). Designated areas have specific designations such as wilderness or botanic areas. MAs include wildland-urban interface, utility corridors, developed recreation sites, and other places such as Red Butte and Bill Williams Mountain that call for special site-specific management.

Chapter 4 – Suitability is the appropriateness of applying certain resource management practices to a particular area of land in consideration of the relevant social, economic, and ecological factors. Suitability is determined based on compatibility with desired conditions and objectives in the plan area. Suitability is determined for timber production, livestock grazing, recreation, minerals, and energy resource activities. Descriptions of the criteria used in making the determinations are provided along with the results. The identification of an area as suitable for a particular use or uses is guidance for project and activity decision making and is not a

commitment or a final decision approving projects and activities. It also does not mean that a particular use will or will not occur in the area.

Chapter 5 – Monitoring and evaluation of plan implementation is used to determine progress toward achieving desired conditions and objectives, and to determine how well management requirements, such as standards and guidelines, are being applied. The monitoring strategy provides a framework for subsequent monitoring and evaluation designed to inform adaptive management.

Plan Consistency

As required by the National Forest Management Act (NFMA) and the National Forest System Land Management Planning Rule, all projects and activities authorized by the Forest Service must be consistent with the plan by being consistent with applicable plan components (decisions). In addition to consistency with plan direction, Forest projects and activities are developed to be consistent with applicable laws, regulations, and policies. “Projects and activities” cover all actions under 16 U.S.C. 1604(i).

When a proposed project or activity is not consistent with a plan component, the responsible official has the following options:

- Modify the proposal so that the project or activity will be consistent;
- Reject the proposal; or
- Amend the plan contemporaneously with the approval of the project or activity so that the project or activity is consistent with the plan as amended. The amendment may be limited to apply only to the project or activity.

Plan Implementation

Project-level planning is the mechanism for plan implementation. Project planning translates the desired conditions and objectives in the plan into proposals that identify specific actions, design features, and project-level monitoring. Proposal development for projects addresses site-specific needs developed locally with input from experts and stakeholders and consideration of the most current and relevant information. Project decisions are made following public involvement and analysis. Important considerations in project development include consistency with the plan, consistency with higher-level direction, projects’ potential effects on achieving desired conditions at multiple scales, and feedback from project- and plan-level monitoring regarding the effectiveness of management strategies.

Forest projects and activities are to be consistent with the direction in this plan as well as with that from current law, regulation, and policy. This plan does not reiterate higher-level direction; instead, it includes a partial list of applicable laws, regulations, executive orders, and policy for reference in Appendix B.

In order to ensure a project is consistent with the plan, its design and implementation should consider its setting, any Management Areas it overlaps, and the guidance for any resources or conditions that may be present in the area (e.g. cultural resources, nonnative species, geologic formations, wildlife, etc.). Additionally, it should consider any potential conflicts with other authorized projects and activities. Project design should be consistent with Forest-wide plan direction except where superseded by Management Area direction, which takes precedence.

When using this plan to develop project specifications, it is important to keep in mind that desired conditions for all scales are applicable regardless of the size of the project. Smaller projects need to consider the larger scales in terms of how they contribute to the desired conditions within the context of the larger-scale unit, and larger projects need to consider the design features required to ensure that the fine scale desired conditions are achieved and maintained across the project area.

Consideration of scale is also important when evaluating progress toward desired conditions because the range of variability and distribution of conditions is affected by the scale at which they are viewed. For example, when desired conditions are articulated at larger scales, they represent an average of fine-scale conditions across broader areas. This may make conditions appear less variable when they are evaluated at large scales, even though variability exists at the smaller scales.

Plan- and project-level monitoring and evaluation are the tools for gathering information on progress toward desired conditions, the effectiveness of plan implementation, and the appropriateness of plan direction. This information is subsequently used to determine management needs and adjust management strategies, which, in part, determine the form of future projects and activities. As such, monitoring and evaluation are key elements of plan implementation, as they guide future management occurring under the plan. The monitoring plan contained in Chapter 5 of this document, in conjunction with project-level monitoring, will provide the framework for enabling adaptive management on the Kaibab NF.

Chapter 2. Forestwide Desired Conditions and Strategies

This chapter lays out the desired conditions and the strategies the Kaibab NF intends to use to achieve them. Desired conditions define what the Kaibab NF should look like and what goods and services it should provide. Strategies consist of objectives, standards, and guidelines; they define when, where, and how to achieve the desired conditions. They define the actions needed to move toward desired conditions and the sideboards needed to constrain those actions in the form of objectives, standards, and guidelines.

Throughout this chapter, plan components (plan decisions) are displayed within text boxes. Text outside of boxes does not constitute plan decisions; it is background material, explanations, or descriptions of management approaches.

Desired conditions and strategies (objectives, standards, and guidelines) related to the major vegetation types are presented first in this plan because they provide the setting or habitat where the other resources occur and activities take place. These desired conditions are integrated and are intended to reflect not only healthy ecological systems, but also the social and economic considerations needed for long-term sustainability.

Forest Resources

Major Vegetation Community Types

The major vegetation communities on the Kaibab NF are presented in the order from those occupying the greatest acreage to the least. The mapped boundaries of the vegetation communities are based on of the potential natural vegetation type that would occur in the presence of natural disturbance processes such as fire. Appendix E displays the approximate location and area of the major vegetation community types on the Kaibab NF. The PNVT determination for a specific location is should be based on soils and other site-specific indicators.

Pinyon-juniper Communities

The pinyon-juniper vegetation communities are collectively composed of the pinyon-juniper grassland, pinyon-juniper sagebrush, and pinyon-juniper persistent woodland communities. Pinyon-juniper communities generally occur at elevations between 5,300 and 7,400 feet. They occur on all three districts and cover about 630,000 acres on the Kaibab NF. Pinyon-juniper communities are the setting for a variety of uses and activities including wood cutting, livestock grazing, camping, hunting, and pinyon nut gathering.

Under their natural disturbance regime, these plant communities are dominated by one or more species of pinyon pine and/or juniper with at least 10 percent tree canopy. Pinyon is occasionally absent, but one or more juniper species are always present. They can occur with a grass/forb-dominated understory (pinyon-juniper grasslands forest communities), a shrub-dominated understory (pinyon-juniper sagebrush forest community), or a sparse discontinuous understory of some grasses and/or shrubs (pinyon-juniper persistent woodland forest community). Two-needle pinyon pine (*Pinus edulis*) is common; as well as one-seed (*Juniperus monosperna*), Utah (*J. osteosperma*), Rocky Mountain (*J. scopulorum*), and alligator (*J. deppeana*) juniper. Much of the

pinyon-juniper vegetation communities are currently denser than they were historically because of changes in wildfire occurrence. Greater tree density has increased competition for water and nutrients. This, in turn, has caused a reduction in understory plant cover and diversity, a loss of ground cover, and subsequent increases in soil erosion.

Pinyon-juniper communities provide important winter and spring range for wildlife. Mature pinyon-juniper stands are particularly important for several bird species of conservation concern, many of which rely on the habitat features provided only by mature stands. Such features include large-diameter trunks for nest cavities and greater berry and seed production. On the North Kaibab Ranger District, pinyon-juniper habitat provides primary and critical winter range and transitional habitat during migration for mule deer. Similarly, pinyon-juniper habitat on the Williams and Tusayan Ranger Districts provides winter and transitional range for elk and other game species.

Desired Conditions Common to All Pinyon-juniper Communities

- Pinyon-juniper communities occur as a shifting mosaic interspersed with openings across the landscape. The configuration of vegetation and openings provides foraging and browsing opportunities for wildlife, and enough sighting distance and hiding cover for pronghorn to escape predators.
- Old growth occurs throughout the landscape, generally in small areas as individual components, or as clumps. The location of old growth shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality).
- At the mid-scale and above, canopy cover is at least 10 percent with a mix of young and mature groups and clumps of trees.
- The mature groups of trees are structurally diverse, containing large live trees, as well as trees with dead or broken tops, gnarls, and burls. Snags, green snags, and downed trees > 10″ at root collar are present and average 1 to 2 per acre. Some tree groups have 30 to 40 percent canopy cover that provides habitat for nesting, bedding, and foraging.
- The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances (e.g. insects, diseases, and fire) and climate variability.
- Plant litter (leaves, needles, etc.) and understory plant cover contributes to soil stabilization, prevents erosion, promotes nutrient cycling, improves water retention, provides cover and forage for small mammals, and conditions necessary for pinyon seed germination.
- Nurse trees provide understory microclimate with improved nutrient and soil properties, higher soil moisture, lower temperatures, and lower light levels, which increases the survival of pinyon seedlings under harsh conditions.
- There are opportunities for collecting forest products (firewood, pinyon nuts, posts, and poles, etc.) in a manner consistent with other desired conditions.
- A robust crop of pinyon pine nuts is regularly produced.

Pinyon-juniper Grasslands

The pinyon-juniper grassland vegetation community is composed of the pinyon-juniper grassland and juniper grassland vegetation types. Pinyon is occasionally absent, but one or more juniper species are always present. Except in some post-fire communities, these areas historically had at least 10 percent tree canopy cover with an understory dominated by grassland species, often on deep soils with gentle topography. Areas that historically had less than 10 percent tree canopy cover are classified as grasslands. This distinction is necessary for differentiating between vegetation types and their respective desired conditions, but it is recognized that transition between pinyon-juniper grasslands and grassland savanna actually occurs along a gradient.

Desired Conditions for Pinyon-juniper Grasslands

- Pinyon-juniper grasslands are generally uneven-aged and open in appearance. Trees occur as individuals, but occasionally are in small groups and range from young to old.
- Scattered shrubs and a dense herbaceous understory including native grasses, forbs, and annuals are present. A herbaceous understory maintains soil productivity, provides quality habitat, resists soil erosion, and can support frequent, low-intensity surface fires.
- The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances (including insects, diseases, and fire) and climate variability.
- Understory composition is within the natural range of variability and contains diverse native herbaceous plant species that provide nutrition for pronghorn and other species.
- Depending on soil type and vegetation potential, bare soil varies between 10 and 60 percent. Basal vegetation varies between 5 and 50 percent ground cover. Organic litter varies between 30 and 50 percent of the ground cover. The relative proportion of vegetation canopy cover averages 40 to 60 percent grass, 10 to 30 percent forbs, and 5 to 20 percent shrub.
- Fires are typically low severity with a 0- to 35-year return interval (Fire Regime I).

Pinyon-juniper Sagebrush (Pinyon-juniper Shrub)

In the pinyon-juniper sagebrush vegetation community, sage is the dominant shrub in most areas. In some areas other shrub species may be dominant and sagebrush may not even be present. This vegetation type may better be described as pinyon-juniper shrublands, but for consistency with the potential natural vegetation types (PNVTs) identified for the Southwestern Region, they are referred to as pinyon-juniper sagebrush communities.

Pinyon-juniper sagebrush communities are concentrated in areas dominated by cold season precipitation regimes. They are usually found on sites with coarse-textured, gravelly, or lithic soil characteristics. Pinyon is occasionally absent, but one or more juniper species are always present. These systems have open woodland canopies interspersed with Colorado Plateau and Great Basin shrub species such as big sagebrush (*Artemisia tridentata* Nutt.), rubber rabbitbrush (*Ericameria nauseosa* (Pall. Ex (Pursh)), fourwing saltbush (*Atriplex canescens* (Pursh) Nutt.), and winterfat (*Krascheninnikovia lanata* (Pursh)).

Typical disturbances include fire, insects, and disease. Contemporary disturbances include mechanical removal of overstory trees. Fire absence since Euro-American settlement has not

resulted in dramatic increases in tree densities as with other woodland types, presumably since fire occurrence may not have been significantly altered in this community type following Euro-American settlement.

Desired Conditions in Pinyon-juniper Shrub

- The pinyon-juniper sagebrush shrub forest type is a mix of trees and shrubs that occur as shifting vegetation states (herbaceous dominated, shrub dominated, and tree dominated) in even-aged and uneven-aged patches with a variable understory. There is a mix of large and small to mid-size juniper.
- The shrub component consists primarily of sagebrush, but oak, cliffrose, and other shrub species may also be present. Depending on structural stage, the understory is dominated by shrubs. The shrub component consists of one or more shrub species, which are well distributed. Shrubs typically are in a closed-canopy state during the later successional stages.
- Litter and rock comprise the greatest percentage of ground cover. Grasses and forbs are sparse due to shrub dominance.
- The composition, structure, and function of vegetation conditions are resilient to the frequency, extent, and severity of disturbances including insects, diseases, fire, and climate variability.
- Fires are mixed to high severity and have return intervals of 35 to more than 200 years (Fire Regimes III, with occurrences of stand replacing fire at longer intervals).

Pinyon-juniper (Persistent) Woodlands

Persistent woodlands communities are scattered and not associated with a particular soil type, but occur where soils are thin and rocky. Historically, they were found on rugged upland sites that were not capable of developing an understory that could carry fire.

Desired Conditions for Pinyon-juniper Woodlands

- Pinyon-juniper woodland (persistent) is characterized by even-aged patches of pinyons and junipers that at the landscape level form uneven-aged woodlands. Tree density and canopy cover are high, shrubs are sparse to moderate, and herbaceous cover is low and discontinuous due to soil and other site conditions.
- Some very old trees (>300-years old) are present.
- Disturbances rarely affect the composition, structure, and function. Insects, disease, and mistletoe occur at endemic levels. Fire disturbance is infrequent and variable due to lack of continuous ground cover.
- Fires are mixed to high severity, but generally stand replacing, occurring infrequently at intervals of 200 years or more (Fire Regime V).

Guidelines for Management Activities in Pinyon-juniper Communities

- The pinyon-juniper vegetation communities (pinyon-juniper grassland, shrubland, or woodland) should be determined before developing project proposals to ensure the applicable desired conditions are applied.
- Restoration efforts should emphasize the retention of groups of mature trees where they occurred historically.
- Where pinyon-juniper obligate species occur (e.g. gray vireo), project design should retain key habitat features including snags, and partially dead or dying trees, and downed logs.
- Pinyon-juniper communities should maintain tree densities that maximize herbaceous plant growth and wildlife species diversity typical for their respective community subtype.
- Project design for vegetation management activities should prioritize treatment areas along known wildlife corridors, in the wildland-urban interface, and in historic openings.
- Restoration treatments in pinyon-juniper should be rotated over time and various successional stages to maximize wildlife habitat and diversity.

Management Approach for Pinyon-juniper Communities

Although management is needed to achieve and maintain desired conditions in pinyon-juniper communities (with the exception of persistent pinyon-juniper woodlands), it was not identified as a priority need for change in the CER/AMS. Due to limited capacity, the Kaibab NF is not currently setting restoration objectives for this vegetation type. To achieve and maintain desired conditions, the Kaibab NF may thin or burn to reduce juniper densities to increase growth and vigor of understory species, reduce fuel loads, improve wildlife habitat, reduce vulnerability to pinyon *Ips* beetles, and increase herbaceous vegetation composition and cover. Strategies to accomplish work include:

- Working collaboratively with tribes, the Arizona Game and Fish Department, and other partners to plan and implement projects that will make progress toward desired conditions, particularly reducing tree density to improve wildlife habitat.
- When possible, allow natural ignitions to be managed for resource benefits and achieve desired conditions.

Following stand replacing fire in pinyon-juniper shrublands and pinyon-juniper woodlands, the return to woodland stand structure can take many decades. Strategies for re-establishing the desired conditions include leaving juniper snags, downed logs, and other woody components that collect drifting seeds, provide shade, cooler temperatures, moisture retention, and protection from ungulate herbivory. These microclimates serve as nurseries for grasses, forbs, and woodland trees, contribute to resilience in times of drought, and provide habitat for small mammals and other wildlife.

See also the Forestwide direction for "Grassland Communities," "Large-scale Disturbance Events in Forested Communities," "Soils and Watersheds," "Nonnative Invasive Species," "Wildlife," "Forestry and Forest Products," and "Wildland Fire Management."

Ponderosa Pine Forests

The ponderosa pine forest vegetation community generally occurs at elevations ranging from 6,200 to 8,200 feet. It is present on all three ranger districts and covers about 541,000 acres of the Kaibab NF. It is dominated by ponderosa pine (*Pinus ponderosa*) and commonly includes other species such as oak, juniper, and pinyon. Species such as aspen (*Populus tremuloides*), Douglas-fir (*Pseudotsuga meziesii*), white fir (*Abies concolor*), and blue spruce (*Picea pungens*) may also be present, but occur infrequently. This forest vegetation community typically occurs with an understory of grasses and forbs, but may include shrubs, such as on the Tusayan Ranger District where sage is sometimes the dominant understory species. Ponderosa pine forests are used by a variety of wildlife including birds, small mammals, elk and mule deer, and are particularly important for tassel-eared squirrels (*Sciurus aberti*) and northern goshawk (*Accipiter gentilis*).

The ponderosa pine forest vegetation community includes two subtypes: ponderosa pine-bunchgrass and ponderosa pine-Gambel oak. Higher densities of Gambel oak (*Quercus gambelii*) are often correlated with higher species richness, and the Gambel oak subtype provides critical nesting and foraging resources for many northern Arizona birds, including Mexican spotted owls.

The ponderosa pine forests are popular places to escape the heat in the summer and are the setting for many recreation activities including camping, hunting, hiking, sightseeing, and wildlife watching. Additionally, this forest type supports a variety of other uses such as livestock grazing, wood harvesting, and collection of firewood, medicinal plants, and other traditionally used products. It is also the primary vegetation type in the wildland urban interface on the Kaibab NF.

Ponderosa pine forests on the Kaibab NF are generally denser and more continuous across all developmental states than in reference conditions. The open, park-like stands characteristic of the reference conditions for ponderosa pine forests promoted greater floral and faunal diversity and fire resilience than the dense stands of today. Accumulations of forest litter and woody debris are much higher than would have occurred under the historical disturbance regime. Lack of fire disturbance has led to increased tree density and fuel loads that heighten the risk of uncharacteristically intense wildfire and drought-related mortality. When fires occur under current (2014) conditions, they tend to kill a lot of trees, including the large and old trees. These trees take longer to replace, moving the Kaibab NF further from desired conditions, and increasing the time it would take to return to desired conditions. There is currently a moderate risk of insect and/or disease outbreak, which is also a function of increased tree density.

Fine-scale (10 acres or less) Desired Conditions for Ponderosa Pine

- Trees typically occur in irregularly shaped groups and are variably spaced with some tight clumps. Trees within groups are of similar or variable ages and may contain species other than ponderosa pine.
- Tree groups are made up of clumps of various age classes and size classes that typically occur in areas less than one acre, but may be larger, such as on north-facing slopes.
- Crowns of trees within the mid-aged to old groups are interlocking or nearly interlocking and consist of approximately 2 to 40 trees per group.
- The interspaces between groups are variably shaped, are comprised of a native grass/forb/shrub mix, and may contain individual trees or snags. Regeneration openings occur as a mosaic and are similar in size to nearby groups.
- Organic ground cover and herbaceous vegetation provide protection for soil and moisture infiltration, and contribute to plant and animal diversity and ecosystem function. Herbaceous vegetation reflects the site potential.
- Where historically occurring, Gambel oak thickets with various diameter stems and low growing, shrubby oak are present. These thickets provide forage, cover, and habitat for species that depend on them such as small mammals, foliage nesting birds, deer, and elk. Gambel oak mast (acorns) provides food for wildlife species. Large tree form oaks, snags, and partial snags with hollow boles or limbs are present.
- Where Gambel oak comprises more than 10 percent of the basal area, it is not uncommon for canopy cover to be greater than 40 percent.
- Isolated infestations of Southwestern dwarf mistletoe may occur, but the degree of severity and amount of mortality varies among the infected trees. Witches' brooms may form on infected trees, providing habitat and food for wildlife and invertebrate species.
- Fires generally burn as surface fires, but single-tree torching and isolated group torching is not uncommon.

Mid-scale (100 to 1,000 acres) Desired Conditions for Ponderosa Pine

- The ponderosa pine forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. The mosaic of tree groups generally comprises an uneven-aged forest with all age classes and structural stages present. Stands are dominated by ponderosa pine, but other native hardwood and conifer species occur. The more biologically productive sites contain more trees per group and more groups per area.
- Basal area within forested areas generally ranges from 20 to 80 square feet per acre, with larger trees (i.e. >18 inches in diameter) contributing the greatest percent of the total basal area.
- Interspaces with native grass, forb, and shrub vegetation are variably shaped and typically range from 10 to 70 percent, with the more open conditions typically occurring on less productive sites.

- Forest conditions in some areas contain 10 to 20 percent higher basal area in mid-aged to old tree groups than in the general forest (e.g., goshawk post-fledging family areas, Mexican spotted owl nesting/roosting habitat, drainages, and steep north-facing slopes).
- Patches of even-aged forest structure are present, but infrequent. Disturbances sustain the overall variation in age and structural distribution.
- Snags and green snags 18 inches diameter at breast height (d.b.h.) or greater average 1 to 2 per acre. Snags and green snags of various sizes and forms are common.
- Downed logs (greater than 12 inches diameter at mid-point and greater than 8 feet long) average 3 logs per acre. Coarse woody debris greater than 3 inches in diameter (including downed logs), ranges from 3 to 10 tons per acre.
- Fires burn primarily on the forest floor and typically do not spread between tree groups as crown fire.

Landscape-scale (over 10,000 acres) Desired Conditions for Ponderosa Pine

- The ponderosa pine forest vegetation community is a mosaic of forest conditions composed of structural stages ranging from young to old trees. The forest is generally uneven-aged and open. Groups of old trees are mixed with groups of younger trees. Occasional areas of even-aged structure are present. Denser tree conditions exist in some locations such as north-facing slopes, canyons, and drainage bottoms.
- The ponderosa pine forest is composed predominantly of vigorous trees, but declining trees are present. Snags, green snags, and coarse woody debris occur across the landscape.
- Where it naturally occurs, Gambel oak is present with all structure classes represented. It is reproducing and maintaining or expanding its presence within its natural range.
- Old growth occurs throughout the landscape, generally in small areas as individual old growth components, or as clumps of old growth. Old growth components include old trees, snags, coarse woody debris, and structural diversity. The location of old growth shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality).
- The landscape is a functioning ecosystem that contains all components, processes, and conditions associated with endemic levels of disturbances (e.g., fire, dwarf mistletoe, insects, diseases, lightning, drought, and wind).
- Forest vegetation conditions are resilient to the frequency, extent, and severity of disturbances and climate variability. Grasses and needle cast provide the fine flashy fuels needed to maintain the natural fire regime. Fire and other disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris loads, and nutrient cycling.
- The risk of uncharacteristic high-severity fire and associated loss of key ecosystem components is low.
- Frequent, low-severity fires (Fire Regime I) occur across the entire landscape with a return interval of 0 to 35 years.

Objectives for Ponderosa Pine

To make progress toward the desired conditions and reduce the potential for active crown fire in ponderosa pine communities at a rate that would maintain the desired conditions over time:

- Mechanically thin 11,000 to 19,000 acres annually.
- Treat an average of 13,000 to 55,000 acres annually, using a combination of prescribed fire and naturally ignited wildfires.[2]

Management Approach for Ponderosa Pine

This plan emphasizes restoration of ponderosa pine forests because these forests are highly departed from desired conditions and were identified as a priority need for change. Projects in ponderosa pine are aimed at restoring forest structure and process (e.g. natural disturbances such as low-severity fire and dwarf mistletoe, watershed function, and nutrient cycling). Additionally, project design features may seek to increase diversity that was historically present by promoting oak, aspen, openings, and understory production. Treatments typically strive to mimic the structure and patterns of reference conditions using historical evidences and soil characteristics. However, treatments may consider other circumstances, desired conditions, and objectives, such as species specific habitat needs. As a result, reconstructed reference conditions are general guides rather than rigid restoration prescriptions.

In ponderosa pine, reintroducing fire as a disturbance agent is critical to restoration. Fire-only treatments may be appropriate for some areas with open canopies and low fuel loads, but mechanical fuel reduction is needed in many areas before fire can be safely reintroduced. Fire management needs to maintain an appropriate balance between smoke impacts and public concerns (health, visibility, etc.). Southwestern dwarf mistletoe is also a natural disturbance agent in ponderosa pine, but in some areas the degree of infection is unsustainable and exceeds desired levels. Treatments for controlling dwarf mistletoe are typically aimed at maintaining infection levels that allow for development of a diversity of age classes across the landscape, not to eliminate this naturally occurring disturbance agent. Tools for creating desired stand conditions and openings include a variety of treatments and uneven-aged cutting methods such as matrix thinning, all-size free thinning, single tree selection, group selection, sanitation and salvage, limited even-aged regeneration cutting, thinning, and managed fire.

In pine-oak forests many individual large Gambel oak trees and oak copses have become over-topped with pine trees. Treatments to promote oak regeneration and establishment are fairly effective, because oak sprouts prolifically after release treatments. Oaks may be cut or burned to stimulate new growth, maintain growth in large-diameter trees, or to stimulate mast production.

Incorporation of design features in thinning and planting prescriptions can also be used to create “living snow fences” for shade, snow accumulation, wind protection, and slow snowmelt, and protect from sublimation caused by prevailing winds. This may help offset the effects of climate change.

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[2] Acrs of lightning caused wildfire counted toward this objective are only those that make progress towards or maintain desired conditions.

Pine-oak forests are managed as Mexican spotted owl (*Strix occidentalis lucida*) habitat as discussed under the approved revised Recovery Plan for the Mexican Spotted Owl (2012). The Kaibab NF works closely with the U.S. Fish and Wildlife Service (USFWS) to address the habitat needs of the Mexican spotted owl by minimizing disturbance and providing nest/roost habitat, which includes managing for areas of closed canopy and desired levels of key structural elements such as large old trees, snags, and downed woody debris.

Illegal wood cutting is probably the biggest threat to oak, as it reduces both the amount and quality of oak habitat. Enforcement, education, and site-specific planning will be necessary to ensure quality oak habitat over the long term. Firewood collection opportunities are managed so site-specific planning and permits may specify the amount and size of oak that can be collected in areas where live and dead woody oak habitat components are limited.

Due to time and budget constraints in the face of increasing risk, the Kaibab NF intends to prioritize and design treatments so they will be most effective. One strategy includes designing treatments that make progress toward desired conditions and retain those characteristics for at least 20 years. In terms of prescriptions, this means that the post-treatment conditions may need to be on the more open end of the desired range to accommodate the growth that is anticipated in the interval between treatments. Additionally, within a given project boundary, some acres may be left untreated if they are already at low risk, or if leaving them untreated meets specific wildlife habitat needs but does not promote undesirable fire behavior at the mid-scale in surrounding treated acres.

Restoration activities would be prioritized in the areas identified by the Kaibab Forest Health Focus (KFHF; NAU 2009) and then move to other areas of high risk and high value. The KFHF was a multi-stakeholder collaborative process that prioritized areas most in need of treatment. Primary indicators were related to high risk and high value such as those with closed canopies containing large trees. These areas were identified as high priority for restoration because they already contain many components of the desired condition and a single treatment may come close to meeting the desired condition, but if lost, would take centuries to replace. The KFHF report can be accessed at *http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5120031.pdf.*

On the Williams and Tusayan Ranger Districts, much of the restoration work needed to attain desired conditions is likely to be implemented through the Four Forest Restoration Initiative (4FRI). The 4FRI is a large-scale, collaboratively driven project with the goal of restoring forest ecosystems on portions of the Coconino, Kaibab, Apache-Sitgreaves, and Tonto National Forests. Coordination with the 4FRI planning effort has been ongoing to ensure consistency with this plan.

See also "Guidelines for Vegetation Management in All Forested Communities," "Large-scale Disturbance Events in Forested Communities," "Wildlife," "Nonnative Invasive Species," "Air Quality," "Forestry and Forest Products," and "Wildland Fire Management" sections of this plan.

Mixed Conifer Forests

Mixed conifer forests occur on the North Kaibab and Williams Ranger Districts and cover approximately 130,000 acres on the Kaibab NF. The mixed conifer forests include three vegetation communities: Frequent fire mixed conifer, mesic mixed conifer, and spruce-fir. Frequent fire mixed conifer forests are the most common and are characterized by a frequent, low-intensity fire regime. Mesic mixed conifer and spruce-fir occur at moister, higher elevation sites, are interspersed with each other, and are less apparent at the landscape scale. Because of their interspersion and similar desired conditions, they are addressed together in this plan.

Frequent Fire Mixed Conifer

The frequent fire mixed conifer forest vegetation community, also referred to as "dry mixed conifer," is a transitional vegetation type with increasing elevation between ponderosa pine and mesic mixed-conifer forest communities. It generally occurs at elevations ranging from 7,200 to 9,500 feet, but occurs at lower elevations in drainages, particularly on steep, north-facing slopes. Ponderosa pine is the most common tree species in the frequent fire mixed conifer community, which distinguishes it from the mesic mixed conifer/spruce-fir community. Historically, shade intolerant trees such as ponderosa pine, southwestern white pine (*Pinus flexilis/Pinus strobiformis*), quaking aspen, and Gambel oak dominated frequent fire mixed conifer forests. Douglas-fir is often present, with lesser amounts of shade tolerant species such as white fir and spruce. This forest community typically has an understory of grasses, forbs, and shrubs.

Fine-scale (10 acres or less) Desired Conditions for Frequent Fire Mixed Conifer

- Trees typically occur in irregularly shaped groups and are variably spaced with some tight clumps. Trees within groups are of similar or variable ages, often containing more than one species. Crowns of trees within mid-aged and old groups are interlocking or nearly interlocking.
- Tree groups are typically less than 1 acre size and consist of 2 to 50 trees per group, but are sometimes larger, such as on north facing slopes. Regeneration openings occur as a mosaic and are similar in size to nearby groups.
- Interspaces between groups are variably shaped, are comprised of a native grass-forb-shrub mix, and may contain individual trees or snags.
- Organic ground cover and herbaceous vegetation provide protection for soil and moisture infiltration, and contribute to plant and animal diversity and ecosystem function. Herbaceous vegetation reflects the site potential.
- Density is variable, with canopy ranging from very open to closed.
- Dwarf mistletoe infections may be present on ponderosa pine and Douglas-fir, and rarely on other tree species, but the degree of infection severity and rate of mortality varies among infected trees. Witches' brooms may be present with these infestations, providing habitat for wildlife.
- Fires generally burn as surface fires, but single-tree torching and isolated group torching is not uncommon.

Mid-scale (100 to 1,000 acres) Desired Conditions for Frequent Fire Mixed Conifer

- The frequent fire mixed conifer forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. Forest appearance is variable, but generally uneven-aged and open; occasional patches of even-aged structure are present. The more biologically productive sites contain more trees per group and more groups per area. Basal area within forested areas generally ranges from 30 to 100 square feet per acre, with larger trees contributing the greatest percent of the total basal area.
- Forest conditions in some areas contain 10 to 20 percent higher basal area in mid-aged to old tree groups than in the general forest; these include goshawk post-fledging family areas, Mexican spotted owl nesting/roosting habitat, and north-facing slopes. Interspaces with native grass, forb, and shrub vegetation typically range from 10 to 50 percent of the area.
- The mosaic of tree groups generally comprises an uneven-aged forest with all age classes and structural stages. Occasionally small patches (generally less than 50 acres) of even-aged forest structure are present. Disturbances sustain the overall variation in age and structural distribution.
- Where they naturally occur, groups or patches of aspen and all structural stages of oak are present.
- Snags and green snags 18 inches d.b.h. or greater average three per acre. Downed logs (greater than 12 inches diameter at mid-point and greater than 8 feet long) average three per acre within the forested area of mid-scale units. Coarse woody debris, including downed logs, ranges from 5 to 15 tons per acre.
- Fires burn primarily on the forest floor and typically do not spread between tree groups as crown fire.

Landscape-scale (over 10,000 acres) Desired Conditions for Frequent Fire Mixed Conifer

- At the landscape scale, the frequent fire mixed conifer forest community is a mosaic of forest conditions composed of structural stages ranging from young to old trees.
- Old growth occurs throughout the landscape, generally in small areas as individual old growth components, or as clumps of old growth. Old growth components include old trees, snags, coarse woody debris, and structural diversity. The location of old growth shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality).
- Forest appearance is variable but generally uneven-aged and open; occasional patches of even-aged structure are present. The forest arrangement is in small clumps and groups of trees interspersed within variably sized openings of native grass-forb-shrub vegetation associations similar to reference conditions. Size, shape, number of trees per group, and number of groups per area are variable across the landscape.

- Denser tree conditions exist in some locations such as north-facing slopes, canyons, and drainage bottoms.
- The frequent fire mixed conifer forest community is composed predominantly of vigorous trees, but declining trees (e.g. snags, top killed, lightning and fire scarred trees) and coarse woody debris (greater than 3 inches diameter) are present and well distributed throughout the landscape.
- The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances and to climate variability. The landscape is a functioning ecosystem that contains all components, processes, and conditions that result from endemic levels of disturbances (e.g., fire, insects, diseases, and wind).
- Dwarf mistletoe is present and infects ponderosa pine and Douglas-fir, but occurs at endemic levels, which allows for the establishment and sustainability of the desired uneven-aged forest structure over time.
- Grasses and needle cast provide the fine flashy fuels needed to maintain the natural fire regime. Fire and other disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling.
- Frequent, low-severity fires (Fire Regime I) occur across the entire landscape with a return interval of 0 to 35 years.

Objectives for Vegetation Management in Frequent Fire Mixed Conifer

To reduce the potential for active crown fire and restore frequent fire mixed conifer communities:

- Burn an average of 1,000 to 13,000 acres annually, using prescribed fire and/or naturally ignited wildfires.[3]
- Mechanically thin 1,200 to 2,100 acres annually.

Management Approach for Frequent Fire Mixed Conifer

The area south and west of North Canyon in the Saddle Mountain Wilderness was identified as a high priority treatment area by the Kaibab Forest Health Focus as it has both high risk and high ecological values. The strategy identified in the KFHF was to address the needs of this area first and then move to other areas of high fire risk. Fire-only treatments may be appropriate for some areas with open canopies and low fuel loads, but mechanical fuel reduction is needed in many areas before fire can be safely reintroduced. There was limited agreement about appropriate treatment intensity and practices among stakeholders. There was agreement that to address these concerns, initial treatments in frequent fire mixed conifer should adopt an experimental design approach to help fill informational gaps and support adaptive learning in these areas.

[3] Onlya acrs of lightning caused wildfire that maintain or make progress towards desired conditions are counted toward this onjective .

The treatment objectives for this vegetation community have a wide acreage range. Treatment with prescribed burns has been shown to be costly, with narrow windows of opportunity. The ability to manage naturally ignited wildfires to achieve resource benefits has been very limited, and much remains to be learned. The number of acres treated each year is likely to increase over the plan period, as new information becomes available about practices and treatment effects, and as adaptive management is implemented. Additionally, as fuel loading is reduced on more acres, there will be an increased ability to let fire play its natural role.

Mixed conifer forests are managed as Mexican spotted owl habitat under the approved "Mexican Spotted Owl Recovery Plan, First Revision" (USFWS 2012). The Kaibab NF works closely with the USFWS to provide for Mexican spotted owl habitat by minimizing disturbance, providing for some areas of denser forest, and managing for desired levels of key structural elements (e.g., large old trees and snags, downed woody debris) important for nesting, foraging, and dispersal.

See also the "Guidelines for Vegetation Management in All Forested Communities," "Large-scale Disturbance Events in Forested Communities," "Wildlife," "Nonnative Invasive Species," "Recreation and Scenery," and "Forestry and Forest Products" sections of this plan.

Mesic Mixed Conifer / Spruce-fir Forests

The mesic (wet) mixed conifer/spruce-fir forest vegetation community generally occurs at elevations ranging from 7,500 to 10,400 feet. Tree species composition varies depending on seral stage, elevation, and moisture availability. The mesic mixed conifer/spruce-fir community may include early seral species such as aspen, Douglas-fir, New Mexico locust (*Robinia neomexicana*), southwestern white pine, or late seral species such as maple (*Acer* spp.), white fir, subalpine fir (*Abies lasiocarpa*), and spruce. Forests dominated by Engelmann spruce (*Picea engelmannii*) intermixed with subalpine fir and aspen occur at the highest elevations such as the top of Kendrick Mountain and the highest elevations on the Kaibab Plateau. Ponderosa pine is only a minor component, which distinguishes it from frequent fire mixed conifer.

Disturbances in mesic mixed conifer/spruce-fir forests typically occur at two spatial and temporal scales: larger infrequent disturbances (mostly fire) and smaller more frequent disturbances (fire, insect, disease, wind). On the Kaibab NF, this vegetation community rarely occurs continuously above the mid- scale (over 1,000 acres). The mesic mixed conifer/spruce-fir vegetation community has an understory of a wide variety of shrubs, grasses, and forbs, depending on soil type, aspect, elevation, disturbance, and other factors.

Fine-scale (10 acres or less) Desired Conditions for Mesic Mixed Conifer/Spruce-fir

- Mid-aged and older trees are typically variably spaced with crowns interlocking (grouped and clumped trees) or nearly interlocking. Trees within groups can be of similar or variable species and ages, contributing to vertical and horizontal heterogeneity.
- Small openings (gaps) are present as a result of past disturbances.
- Organic ground cover and herbaceous vegetation provide protection for soil and moisture infiltration, and contribute to plant diversity and ecosystem function. Understory vegetation reflects site potential.
- Due to the presence of ladder fuels, fires usually burn either with low intensity, smoldering combustion, or transition rapidly in the canopy as passive or active crown fire.

- Dwarf mistletoe infections may be present on Douglas-fir or spruce, and rarely on other tree species, but the degree of infection severity and amount of mortality varies among infected trees. Witches' brooms may be present with these infestations, providing habitat for wildlife.

Mid-scale (100 to 1,000 acres) Desired Conditions for Mesic Mixed Conifer/Spruce-fir

- The size and number of groups and patches vary depending on disturbance, elevation, soil type, aspect, and site productivity. Patch sizes vary, but are frequently hundreds of acres; groups and patches of tens of acres or less are relatively common.
- Forest conditions in some areas contain higher basal area than the general Forest; examples include goshawk post-family fledgling areas, Mexican spotted owl nesting and roosting habitat, and north-facing slopes.
- A mosaic of primarily even-aged groups and patches, which vary in size, species composition, and age is present. Aspen is occasionally present in large patches.
- Density ranges from 20 to 250 square feet of basal area per acre, depending upon disturbance and seral stages of groups and patches.
- The number of snags and downed logs (greater than 12 inches diameter at mid-point, over 8 feet long) and coarse woody debris (greater than 3 inches diameter) vary by seral stage. Snags 18 inches or greater d.b.h. typically range from one to five snags per acre, with the lower range associated with early seral stages and the upper range associated with late seral stages.
- Coarse woody debris, including downed logs, vary by seral stage, with averages ranging from 5 to 20 tons per acre for early seral stages; 20 to 40 tons per acre for mid-seral stages; and 35 tons per acre or greater for late seral stages.
- During moister conditions, fires exhibit smoldering low-intensity surface behavior with single tree and isolated group torching. Under drier conditions, fires exhibit passive to active crown fire behavior with conifer tree mortality up to 100 percent across mid-scale patches (100 to 1,000 acres). High-severity fires generally do not result in areas of mortality exceeding 1,000 acres. Other smaller disturbances occur more frequently.
- Grass, forb, and shrub-dominated openings created by disturbance may make up 10 to 100 percent of the mid-scale area, depending on the disturbance type. These openings provide areas for future regeneration.
- Fire and other disturbances maintain overall desired tree density, structure, species composition, presence of coarse woody debris, and nutrient cycling.
- Fire severity is mixed or high, with a fire return interval of 35 to over 200 years (Fire Regimes III, IV, and V).

Landscape-scale (over 10,000 acres) Desired Conditions for Mesic Mixed Conifer/Spruce-fir

- The vegetation community is a mosaic of structural and seral stages ranging from young trees through old and is composed of multiple species. The landscape arrangement is an assemblage of variably sized and aged groups and patches of trees and other vegetation similar to reference conditions.
- The landscape is composed predominantly of vigorous trees, but older declining trees (e.g. snags and top killed, lightning-, and fire-scarred trees), as well as coarse woody debris, are present.
- The forest landscape is a functioning ecosystem that contains all components, processes, and conditions that result from endemic levels of disturbances (e.g. insects, diseases, wind, snow, and fire), including snags, downed logs, and old trees.
- The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances and climate variability.
- Dwarf mistletoe infestations may be present in stands that are composed of Douglas-fir or spruce and rarely in other tree species. Infestation size, degree of severity, and amount of mortality varies among infested stands. Witches' brooms may be scattered throughout the infestations providing structural diversity in the stand and improved foraging and nesting habitat for wildlife species such as small mammals (e.g. tree squirrels) and raptors (e.g. goshawks, spotted owls).
- Old growth generally occurs over large areas as stands or forests. Old growth includes old trees, snags, coarse woody debris, and structural diversity. The location of old growth shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality).
- Mixed severity fire (Fire Regime III) is characteristic at the lower elevations of this type. High-severity fires (Fire Regime IV & V) are more common at the higher elevations.

Management Approach for Mesic Mixed Conifer/Spruce-fir

No objectives have been set for the mesic mixed conifer/spruce-fir vegetation types. Potential projects in these areas include burning and mechanical treatments to restore the desired conditions, which were generally much less dense with far fewer shade tolerant trees. The ability to manage naturally ignited wildfires and use prescribed burns to achieve resource benefits has been limited. Limited agreement about treatment intensity and practices among stakeholders calls for initial treatments to include provisions for an experimental design approach and facilitation of multiparty monitoring to increase learning, agreement, and trust.

Mixed conifer forest is managed as Mexican spotted owl habitat under the approved "Mexican Spotted Owl Recovery Plan, First Revision" (USFWS 2012). Kaibab NF works closely with the USFWS to address the habitat needs of Mexican spotted owls by minimizing disturbance and providing nest/roost habitat, which includes managing for areas of closed canopy forest and desired levels of key structural elements, such as large old trees, snags and downed woody debris.

See also the "Guidelines for Vegetation Management in All Forested Communities," "Forestry and Forest Products," "Wildlife" and "Wildland Fire Management" sections of this plan.

Aspen

Aspen is not considered a distinct vegetation community on the Kaibab NF because it typically exists as smaller stands within a larger forest matrix dominated by ponderosa pine or mixed conifer vegetation. As a result, aspen is addressed as a component of other forested communities. Aspen occurs most extensively on the North Kaibab Ranger District at higher elevations and is estimated to cover about 25,000 acres. On Williams Ranger District, the aspen is generally found in small separate patches for a total acreage of approximately 2,000 acres, and on the Tusayan Ranger District is known only as three small clones totaling about 1 acre.

At higher elevations, aspen stands can be expansive due to establishment after large-scale disturbances such as blowdowns or high-severity fires. At mid-elevations, aspen can be common in wet meadows or on mountain slopes, but can also occur in small isolated patches on rock outcrops or steep slopes. At the lower elevations of its range where precipitation is a limiting factor, aspen is generally confined to specific microsite areas such as near springs and meadows, steep, rocky drainages, and side slopes.

Aspen is not usually a climax species on the Kaibab NF; rather, it is part of the mix of early seral species that are common after disturbances, particularly fire. In the West, dry environmental conditions rarely allow for successful establishment of new aspen seedlings, but major disturbance events can facilitate seedling germination. More typically, aspen reproduces asexually through root suckers that are a clone of the original parent tree. Fire and human disturbances regenerate this shade intolerant species by opening up the canopy and removing conifers from the understory. Without disturbance, conifers gradually overtop aspen, closing the canopy, and eventually killing mature aspen trees and reducing regeneration. Aspen is highly susceptible to browsing and disease or death due to bark injuries. Further declines in aspen would result in a loss of diversity that could affect avifauna and invertebrates, including pollinators. The loss of aspen can change fire behavior because aspen typically reduces fire intensity and slows fire spread where it is intermingled with coniferous species.

Aspen stands are currently in decline throughout most of the Southwest as a result of fire absence, unmanaged forest succession, drought, and ungulate overbrowsing. On the Williams Ranger District, most stands are generally considered unhealthy. These aspen stands are dying or are dead because they have been overtopped by conifers and are unable to recruit new individuals due to heavy browsing and bark stripping by ungulates.

Aspen stands generally occur on moister sites and tend to have higher biodiversity and a greater abundance of plants, fungi, invertebrates, mammals, and cavity-nesting bird species than the surrounding forest. Aspen is second only to riparian ecosystems in biological diversity on the Kaibab NF, and supports more bird species than other forested areas. Even small aspen stands provide refugia. The soft wood of decaying stems and snags provide valuable habitat, particularly for cavity-dependent species.

Aspen also has high scenic value. The green leaves and white trunks of aspen provide a natural contrast to the surrounding forest. Aspen attracts both residents and visitors to northern Arizona to enjoy abundant wildlife, shade, and scenery. During the fall months, the landscape is transformed into a patchwork of green and gold, drawing fall color lovers from around the State. Aspen provides unique and seasonal opportunities for hiking, biking, bird watching, nature exploration, picnicking, and other recreational activities.

Desired Conditions for Aspen (General)

- Aspen stands are characterized by disturbances that may include fire, mechanical treatments, insects, pathogens, and abiotic factors. Collectively, these agents of change promote healthy tree regeneration, decadence, and nutrient cycling. These processes further contribute to high quality wildlife habitat and biodiversity.
- Aspen occurs in natural patterns of abundance and distribution at levels similar to or greater than those at time of plan approval.
- Aspen is successfully regenerating and recruiting into older and larger size classes.
- Size classes have a natural distribution, with the greatest number of stems in the smallest classes.
- Fire intervals are similar to reference conditions and maintain aspen.
- Understory vegetation consists of shrubby or herbaceous species, providing forage and cover for wildlife and habitat for invertebrates such as pollinators.
- Aspen provides opportunities for scenic enjoyment, recreation, and cultural or spiritual experiences.

Desired Conditions for Aspen in Ponderosa Pine and Frequent Fire Mixed Conifer

- In ponderosa pine and frequent fire mixed conifer vegetation types, the size, age, and spatial extent of aspen stands reflect reference conditions.
- Within aspen stands on the Tusayan and Williams Districts, coniferous species comprise less than 10 percent of the overstory.
- Isolated aspen stands, diverse in vegetation structure and composition, provide wildlife refugia and diversity in an otherwise conifer-dominated landscape.

Desired Conditions for Aspen in Mesic Mixed Conifer/Spruce-fir Forests

- Downed aspen and woody debris are scattered across the landscape and provide habitat for a variety of wildlife species (e.g., small mammals, reptiles, amphibians, and birds) while contributing to efficient nutrient cycling.
- Aspen occurs as a shifting mosaic across its range with new aspen clones establishing over time.
- The size, age, and spatial extent of aspen stands reflect large-scale disturbance patterns and processes.

Objectives for Restoring Aspen on the Williams and Tusayan Ranger Districts

To protect, enhance, and expand regenerating aspen stands that are considered to be of particularly high ecological and socioeconomic conservation value:

- Fence 200 acres of aspen within 10 years of Plan approval to exclude ungulates.
- Reduce conifer encroachment on 800 acres of aspen within 10 years of Plan approval.

Guidelines for Aspen Management

- Small patch clear-cuts (less than 5 acres in size), conifer removal, and wildland fire should be used to stimulate aspen sprouting in areas that have or previously had aspen.
- Aspen trees 10 inches or greater d.b.h. (both live and dead) should be protected during project activities, except where they may pose a risk to safety, fences, or regeneration efforts.
- Fences should be regularly inspected and maintained while aspen recovers. Fences should be removed when no longer needed.

Management Approach for Aspen Management

Prioritize aspen restoration efforts by their ecological and genetic contribution to the greater landscape and balance these activities with the Kaibab NF's capacity to achieve desired conditions. Collaborate with stakeholders to develop an aspen management protocol that uses a systematic approach to recover and sustain aspen and the associated understory native plant communities and wildlife. Work with the Arizona Game and Fish Department (AGFD) on developing appropriate strategies for managing elk impacts to aspen on the Williams and Tusayan Ranger Districts and identifying population goals for elk on the Kaibab NF. Other strategies to promote aspen such as jackstrawing, planting, public education, and improving the forage and browse in the surrounding area to diffuse browse pressure on aspen may be used.

See also relevant vegetation types, "Wildlife," "Nonnative Invasive Species," and "Forestry and Forest Products."

Standards for Vegetation Management in All Forested Communities

- The maximum size opening that may be created in one harvest operation for the purpose of creating an even-aged stand shall not exceed 40 acres except when it is following a large-scale disturbance event such as a stand replacing fire, wind storm, or insect or disease outbreak.
- When openings are created with the intent of regeneration, effort shall be made to ensure that lands can be adequately restocked within 5 years of final harvest.
- Clearcutting shall only be used where it is the optimum harvesting method for making progress towards the desired conditions.

Guidelines for Vegetation Management in All Forested Communities

- Projects in forested communities that change stand structure should generally retain at least historic frequencies of trees by species across broad age and diameter classes at the mid-scale. As such, the largest and oldest trees are usually retained.
- On suitable timberlands, projects should retain somewhat higher frequencies of trees across broad diameter classes to allow for future tree harvest.
- Project design should manage for replacement structural stages to assure continuous representation of old growth over time.
- Project design and treatment prescriptions should generally not remove:
  - Large, old ponderosa pine trees with reddish-yellow, wide platy bark, flattened tops, with moderate to full crowns and large drooping or gnarled limbs (e.g. Thomson's age class 4, Dunning's tree class 5 and/or Keen's Tree Class 4, A & B [appendix C]).
  - Mature trees with large dwarf mistletoe induced witches' brooms suitable for wildlife nesting, caching, and denning, except where retaining such trees would prevent the desired development of uneven-aged conditions over time.
  - Large snags, partial snags, and trees (>18 inches d.b.h.) with broken tops, cavities, sloughing bark, lightning scars >4 inches wide, and large stick nests (>18 inches in diameter).
  - Gambel oak >8 inches, diameter at root collar.
  - Known bat roost trees.
- The location and layout of vegetation management activities should effectively disconnect large expanses of continuous predicted active crown fire.
- Vegetation management prescriptions should provide for sufficient canopy breaks to limit crown fire spread between groups, allow for the redevelopment and maintenance of a robust understory, and mimic the spatial arrangement of the reference conditions.
- Vegetation management activities in mixed conifer forests should incorporate experimental design features and monitoring to accelerate learning and adaptive management. Trees established after 1890 should generally not be retained in areas where biophysical conditions would have supported stable openings over time.

- Vegetation management activities should meet or exceed goals for scenic beauty (scenic integrity objectives) by creating natural patterns, structure and composition of trees, shrubs, grasses, and other plants.
- Vegetation management should favor the development of native understory species in areas where they have the potential to establish and grow.
- Even aged silvicultural practices may be used as a strategy for achieving the desired conditions over the long term, such as bringing dwarf mistletoe infection levels to within a sustainable range, or old tree retention.
- Seed and plants used for revegetation should originate from the appropriate PNVT and general ecoregion (i.e. southern Colorado Plateau) as the project area.
- Heavy equipment and log decks should not be staged in montane meadows.

See also "Recreation and Scenery," "Nonnative Invasive Species," "Wildlife", "Threatened, Endangered, and Sensitive Species", "Caves, Karst, and Mines", and relevant major vegetation communities.

Management Approach for Vegetation Management

The above Standards for Vegetation Management are required for meeting the intent of the National Forest Management Act. On the Kaibab NF, the predominate vegetation management strategies are for uneven-aged management systems. This is because vegetation management objectives were only developed for the ponderosa pine and frequent fire vegetation types, both of which have uneven aged desired conditions. Even aged management prescriptions are, however, used as a strategy for achieving the desired uneven-aged conditions over the long term. Even-aged prescriptions are appropriate when they would increase or maintain a trajectory toward desired conditions such as to regenerate aspen or when mistletoe infections are moderate to severe and the ability of the area to achieve the desired conditions has been significantly impaired.

Large-scale Disturbance Events in Forest and Woodland Communities

There has been a trend toward more large-scale disturbance events such as large, stand-replacing fires and/or bark beetle epidemics. Following large-scale disturbance events, the desired conditions for the area would generally not change, except in cases where the environment has been so altered that the desired conditions are no longer obtainable. However, there is a need for management actions to accelerate progress toward the desired conditions.

Objectives Following Large-scale Disturbances

To reestablish conifer trees in areas with inadequate seed source and reduce the time to achieve the desired forest structure:

- Plant 300 to 700 acres annually. [4]

[4] This rate is based on the anticipated capacity and may not meet the entire need.

Guidelines for Activities Following Large-scale Disturbances

- Threats to human safety and property should be promptly addressed following large disturbance events using measures such as signage and temporary closures.
- Recovery and restoration project design should seek to establish a trajectory toward the desired conditions for the affected vegetation type.
- Erosion control measures should be implemented to protect significant resource values and infrastructure such as stream channels, roads, structures, and archaeological or historic sites.
- Where extensive tree mortality results from fires, insect and disease epidemics, or wind events, and sufficient timber value exists, salvage of dead trees should be considered where it would meet public safety objectives and facilitate long-term restoration.
- When salvage logging is proposed, planning and implementation should not be delayed; shorter time frames reduce the risk to operations personnel and preserve wood value. Practices that restore nutrient cycling and stabilize soils (revegetation, mulching, lop and scatter, etc.) should be implemented.
- Where conifer seed sources are lost or poorly distributed due to high-intensity fire, artificial regeneration (planting, etc.) should be implemented to promote the desired forest structure and accelerate the recovery of habitat conditions for native wildlife species.
- Some snags and coarse woody debris should be retained to provide for wildlife habitat, soil stabilization, and other resource benefits. Some clumps of large (18 inches or greater d.b.h.) standing dead trees should be retained. Snag retention should be balanced with desired fuel levels over time.
- Project design should incorporate measures to protect regeneration and reforestation investments.
- The "Kaibab NF Recreation Opportunity Settings and Scenery Management Guidebook"[5] should be used when designing restoration projects.

Management Approach for Response to Uncharacteristic Disturbances

When high intensity, stand-replacing fires occur in the ponderosa pine and frequent fire mixed conifer PNVTs, it can take more than 100 years for the characteristic landscape to become restored, regardless of management activities. There is a need for a consistent, efficient, scientifically based response to these events, as they are likely to occur during the planning period. It is important for project design criteria to include both short and long-term provisions for restoring scenic integrity, especially in sensitive foreground areas. Proceeds from the sale of dead trees can be used to offset some of the costs of restoration efforts.

[5] The "Kaibab National Forest Recreation Opportunity Settings and Scenery Management Guidebook" (USDA 2004) is updated as needed and provides more detailed information about plan implementation.

Following stand replacing fire in pinyon-juniper shrublands and pinyon-juniper woodlands, the return to woodland stand structure can take many decades. Strategies for re-establishing the desired conditions include leaving juniper snag, downed logs, and other woody components that collect drifting seeds, provide shade, cooler temperatures, moisture retention, and protection from ungulate herbivory. These microclimates serve as nurseries for grasses, forbs, and woodland trees, contribute to resilience in times of drought, and provide habitat for small mammals and other wildlife.

See also "Recreation and Scenery," "Wildlife", "Threatened, Endangered, and Sensitive Species", "Nonnative Invasive Species," and relevant major vegetation communities.

Sagebrush Shrublands

Sagebrush shrubland communities in northern Arizona represent the southernmost reach of the greater sagebrush biome that covers much of the western United States and parts of southwestern Canada. On the Kaibab NF, the sagebrush shrubland vegetation community generally occurs at elevations between approximately 4,600 and 7,500 feet on the North Kaibab and Tusayan Ranger Districts and covers approximately 89,500 acres. At this southern extreme, the temperature and precipitation regime can limit the extent of grass cover in the sagebrush shrubland. The Kaibab NF contains a disproportionate amount of sagebrush compared to the greater ecoregions (USDA 2009). These communities are dominated by sagebrush (Wyoming big sagebrush [*Artemisia tridentata ssp. Wyomingensis*], Basin big sagebrush [*A. t. ssp. Tridentate*], Bigelow sagebrush [*A. bigelovii*], black sagebrush [*A. nova*], and sand sagebrush [*A. filifolia*]), although other shrub species (e.g., rabbitbrush [*Chrysothamnus spp., Ericameria* spp.], saltbush [*Atriplex* spp.]), and succulents (e.g., yucca [*Yucca* spp.], cactus [*Opuntia* spp.]) occur and can dominate locally.

The understory—typically sheltered by the shrub overstory—consists of a variety of taller forbs and bunch grasses, low-growing grasses and forbs, or well developed cryptobiotic crusts. Plant cover is usually not continuous. Species composition varies by location. Fire disturbance is highly variable in type and frequency across elevation and moisture gradients and site productivity. Reference conditions indicate that about two-thirds of the sagebrush shrublands had mixed-severity fire occurring approximately every 120 years, and about one-third of the sagebrush shrublands had stand-replacing fire occurring at a longer interval (up to 240 years).

Sagebrush provides variable habitat that can include a mix of shrublands and grasslands. This diversity supports an abundance of birds, animals, and native plants, some of which are specially adapted to the system. Overall, wildlife species diversity may be lower in sagebrush systems than in habitat types with greater vertical complexity, but the species that occur in sagebrush systems often occur nowhere else. Sagebrush shrublands provide important habitat for several migratory bird species. Populations of many bird species that depend on these ecosystems are in decline, and many have special conservation status. On the Kaibab NF, species that depend on shrub steppe habitat include Brewer's sparrow (*Spizella breweri*), sage sparrow (*Amphispiza belli*), and sage thrasher (*Oreoscoptes montanus*) (AGFD species of greater conservation needs), green-tailed towhee (*Pipilo chlorurus*) and black-throated sparrow (*Amphispiza bilineata*). The following desired conditions are intended to address these habitat needs.

Desired Conditions for Sagebrush Shrublands

- The composition, structure, and function of biotic and abiotic components of sagebrush shrublands are within or moving toward reference conditions. The majority of sagebrush is in mid-seral or mature states.
- Enough shrub cover exists to meet the needs of a variety of sagebrush obligate wildlife species.
- A vigorous, but not necessarily dense, understory community of native grasses and forbs is present. Understory vegetation reflects the site potential.
- Single trees or groups of trees cover less than 10 percent of any sagebrush shrubland terrestrial ecosystem survey (TES)[6] map unit polygon and less than 5 percent of the community.
- Shrub cover is at least 5 percent, and typically makes up 20 to 50 percent of any sagebrush shrubland TES soil unit.
- Characteristic disturbances play a role in the function of the ecosystem.

Guidelines for Vegetation Management in Sagebrush Communities

- Prior to developing project proposals for restoring sagebrush communities, a determination should be made of the sagebrush subspecies because the differing subspecies indicate different desired reference conditions.
- Management activities should be designed to mimic the historic disturbance.
- Where sagebrush communities are degraded, water should be strategically placed to improve animal distribution and reduce grazing impacts.

Management Approach for Sagebrush Shrublands

Vegetation management activities may be needed to enhance shrubland diversity, distribution, and productivity to support wildlife.

[6] The terrestrial ecosystem survey (TES; USDA 1991) was published by the Kaibab NF in 1991. It maps and evaluates the terrestrial ecosystems in the Kaibab NF. The TES contains predictions and limitations of soil and vegetation behavior for selected land uses, and highlights hazards and capabilities inherent in the soil, and the impact of selected uses on the environment. It can be used to evaluate and adjust land uses to the limitations and potentials of natural resources and the environment. Full text of the TES can be found online at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5138598.pdf.

Grassland Communities

In northern Arizona, grasslands can consist of various perennial grasses, wildflowers, yucca, cactus, shrubs, and/or trees. Life form composition varies due to fluctuations in the area's diverse topography, elevation, and associated microclimates. Grassland communities on the Kaibab NF are categorized as montane/subalpine, Colorado Plateau/Great Basin, or semi-desert. Collectively, these grasslands, savannas, and mountain meadows border every forest type on the Kaibab NF. Each bears its own unique structure, composition, biological components, and conservation needs.

Historically, these grassland communities had less than 10 percent tree cover and occurred between 4,400 and 8,400 feet in elevation. Impacts from grazing, logging, and fire suppression practices that started in the late 1800s are still discernible on the landscape today. These practices reduced or eliminated the vegetation necessary to carry low intensity surface fires across the landscape, thereby altering the natural fire regimes and allowing uncharacteristic forest succession to take place. Portions of grassland communities across the Kaibab NF have been encroached (i.e., invaded) by coniferous trees due to disruption of the historic fire regimes and historic grazing patterns. These conditions have been further exacerbated by recent increases in invasive, nonnative plants, soil erosion, and low density rural home development on adjacent private lands, which further threaten the ecological integrity of grassland systems on the Kaibab NF.

Grasslands provide important habitat for wildlife including birds, mammals, and herpetofauna (lizards and amphibians). However, functional grasslands are much less abundant than they were historically, which reduces the amount of available habitat for grassland-associated species. Many of these animals—such as Gunnison prairie dogs (*Cynomys gunnisoni*), snakes, and burrowing owls (*Athene cunicularia*)—use the consistent environmental conditions found below ground. Grasslands provide valuable breeding sites and foraging opportunities for both resident and migratory grassland associated birds, which have experienced greater declines than any other group of bird species. Pronghorn use grasslands for both cover and forage.

Desired Conditions for All Grasslands

- Vegetation is dominated by herbaceous plants composed of a mix of native grasses and forbs. The structure, composition, and distribution of vegetation are within the range of natural variability and occur in natural patterns of abundance and diversity, which vary depending on soil type and microclimate.
- Disturbance processes are similar to reference conditions and play a primary role in the function of the ecosystem.
- In pronghorn habitat, understory vegetation provides cover for fawning. Vegetation cover is sufficient for small mammal foraging and songbird nesting.
- Vegetation height and cover are sufficient to support the historic fire return interval.
- Vegetation composition is within the natural range of variability and contains diverse native herbaceous plant species that provide nutrition for pronghorn and other species.
- Depending on soil type, bare soil varies between 5 and 80 percent. Basal vegetation varies between 5 and 60 percent ground cover. Organic litter varies between 30 and 50 percent of

the ground cover. Vegetation composition will average 40 to 60 percent grass, and 10 to 30 percent forbs. Vegetation reflects the site potential.

- Tree and shrub canopy cover are each less than 10 percent.

Objectives for Restoring Grasslands

To restore the extent and quality of grasslands and grassland habitat:

- Reduce tree density to less than 10 percent on 5,000 to 10,000 acres of historic grasslands annually.
- Modify fences and/or install crossings to facilitate pronghorn movement on 50 miles of fence within 10 years of plan approval.

Guidelines for Restoring Grasslands

- Pronghorn fence crossings should be installed along known movement corridors.
- Prior to implementation of grassland restoration treatments, consideration should be given to making the residual firewood available for personal collection.
- In areas where native herbaceous cover is sparse and seed sources are depleted, seeding should be considered.

Management Approach for Grasslands

Restoration of grasslands was identified as a primary need for change due to the relatively recent loss of grassland habitat due to tree encroachment. Potential strategies for implementing grassland restoration treatments include:

- Delineating historic grasslands based on the terrestrial ecosystem soil types that are associated with grasslands (mollisols), evidence of presettlement trees, and historic maps.
- Identifying areas in need of revegetation using TES mapping to guide site potential.
- Prioritizing areas for treatment that are at greater risk of loss and that have the capacity to restore to fully functional, high-quality grasslands.
- Initiating public education efforts so the public can understand how conditions have changed and to gain public support.

Species-specific wildlife needs are addressed on a site-specific basis and considered during project level planning and implementation. For example, where they occur, pronghorn typically benefit from grasses and shrubs greater than 11 inches in height to provide fawns protection from predators during the fawning season. This habitat consideration is, however, dependent in large part on weather. Optimal fawning habitat conditions may not always be achievable due to variable environmental conditions (e.g. winter snow fall and spring precipitation). Project specialists work together to determine achievable conditions that would optimize for wildlife habitat at the site level, and give consideration to follow up monitoring that could assess how well such conditions have been met.

Montane / Subalpine Grasslands

On the Kaibab NF, montane/subalpine grasslands occur at elevations from 6,000 to 8,400 feet. This community covers approximately 48,500 acres across the Kaibab NF and can be found on all three ranger districts, although it is of limited extent on the Tusayan Ranger District. Areas of montane grasslands vary from small patches (less than 10 acres) surrounded by conifer forest to large landscape size areas (for example, Demotte Park, Garland Prairie, Government Prairie, and Pleasant Valley are several thousand acres each). Smaller patches can be circular in shape and coincide with small sinkhole features or long and narrow and coincide with valley bottoms. The montane/subalpine grasslands on the North Kaibab Ranger District are often linear, and as a result, are at a higher risk of loss because trees encroach from the edges and the openings close quickly. They are often forb dominated and are better described as montane/subalpine meadows rather than grasslands.

High-elevation meadows are unique sites that often contain habitat for relict plant species that require cool, moist conditions. As a result, these areas are particularly vulnerable to changes in climate, and are often considered a higher priority for vegetation treatment than areas at lower risk.

Desired Conditions for Montane/Subalpine Grasslands

- Montane and subalpine meadow vegetation has high soil productivity and biological diversity. Native species occur in natural patterns of abundance, composition, and distribution. Vegetation is healthy and at least stable.
- Vegetation and litter are sufficient to maintain and improve water infiltration, nutrient cycling, and soil productivity.

See also "Soils and Watersheds" section.

Management Approach Montane/Subalpine Grasslands

The primary strategies for moving toward desired conditions focus on reducing conifer encroachment from grasslands. Other strategies may be used such as treatments that improve the understory vegetation in the surrounding area, which improves elk and livestock distribution and reduces grazing pressure, as well as providing media and public information focused on the importance of meadows and appropriate activities within wet meadows.

Colorado Plateau / Great Basin Grasslands

Found at between 4,900 and 7,200 feet in elevation on the Tusayan and Williams Ranger Districts, this community consists of approximately 44,000 acres on the Kaibab NF. It consists of mostly grasses and interspersed shrubs, and is typically located in drainage bottoms surrounded by sagebrush or pinyon-juniper habitat. In some cases, ponderosa pine forest is present on the grassland border when it is on a north-facing aspect.

Grass species may include but are not limited to: Indian ricegrass (*Achnatherum hymenoides*), threeawn (*Aristida* spp.), blue grama (*Bouteloua gracilis*), fescue (*Festuca* spp.), needle and thread grass (*Hesperostipa comata*), spike fescue (*Leucopoa kingii*), *Muhlenbergia* spp., James' galleta (*Pleuraphis jamesii*), and Sandberg bluegrass (*Poa secunda*). Shrub species may include

but are not limited to: sagebrush (*Artemesia tridentate* spp.), cliffrose (*Purshia stansburiana*), rabbitbrush (*Chrysothamnus* spp.), saltbush (*Atriplex* spp.), Ephedra (*Ephedra viridis*), snakeweed (*Gutierrezia* spp.), winterfat, and wax currant (*Ribes cereum*). Historically, this vegetation type had less than 10 percent tree cover and 10 percent shrub cover. The area provides valuable winter habitat for deer, elk, pronghorn, and Merriam's wild turkey (*Meleagris gallopavo merriami*).

Desired Conditions for Colorado Plateau/Great Basin Grasslands

- Vegetation height and canopy cover are sufficient to carry fire under low wind conditions to support a 10 to 30-year fire return interval.

Management Approach Conditions for Colorado Plateau/Great Basin Grasslands

Vegetation management activities may be needed to enhance shrub diversity, distribution, and productivity to support wildlife.

Semi-desert Grasslands

Covering about 25,000 acres, semi-desert grasslands are found between 4,400 and 6,400 feet in elevation on the North Kaibab Ranger District. Species composition consists of mostly grasses and interspersed shrubs. Dominant grassland associations/types are blue grama grassland, Indian ricegrass, threeawn, fescue, needle and thread grass, spike fescue, *Muhlenbergia* spp., James' galleta, and Sandberg bluegrass. Shrub species may include but are not limited to: sagebrush, rabbitbrush, saltbush, Ephedra, snakeweed, winterfat, and wax currant. Historically, this vegetation type would have had less than 10 percent tree cover. Semi-desert grasslands provide important winter range for mule deer and year-long habitat to pronghorn and bison.

Desired Conditions for Semi-desert Grasslands

- Vegetation height and canopy cover are sufficient to carry fire under low wind conditions to support fire on a 10 to 30-year return interval.

Management Approach for Semi-desert Grasslands

It is important to work collaboratively AGFD and other state and federal agencies to implement strategies for to maintain and improving habitat for the bison and other wildlife.

Desert Communities

The desert communities vegetation type occupies a proportionately small area of the Kaibab NF, covering only approximately 13,700 acres, but provides habitat for a number of species not found in other areas. It is only found in the Kanab Creek Wilderness. It surrounds the cottonwood-willow forest community and occurs at elevations ranging from 3,000 to 4,300 feet. Vegetation cover is sparse to dense and includes desert grasses, desert shrubs, succulent species, and some herbaceous cover. Fire did not historically play a role in this vegetation community.

Desired Conditions for Desert Communities

- Desert communities are characterized by extensive grasses with a shrub cover less than 30 percent. Vegetation canopy cover ranges from 5 to 40 percent. Shrubs contribute to the native plant diversity and structure. Plant litter occupies up to 5 percent of the soil surface.
- Density of juniper and other shrubby species is maintained at levels that promote natural fire regimes and long fire return intervals. Fire occurrence is low and infrequent. Natural disturbance regimes include soil engineers such as arthropods and sometimes small mammals.
- Rocky outcroppings and shrubby plant species provide abundant browse and foraging opportunities for mule deer and bighorn sheep.
- Native ungulates are free from disease.
- Livestock are absent, except for recreation and administrative packing and riding animals.
- Native plants provide for traditional foods and materials including ephedra, yucca, and prickly pear.

Guidelines for Desert Communities

- Fire should not be used as a vegetation management tool in desert communities.

Management Approach for Desert Communities

In the desert communities of Kanab Creek, it is important to work collaboratively with the AGFD and BLM to implement strategies identified in the "Arizona Strip Desert Bighorn Sheep Management Plan."

See also management area direction for "Recommended Wilderness Areas."

Gambel Oak Shrublands

On the Kaibab NF, the Gambel oak shrubland vegetation community occurs at elevations ranging from 7,000 to 8,600 feet and is associated with relatively steep, rocky, south-facing slopes. Gambel oak shrublands occur on the southern flank of Bill Williams Mountain on the Williams Ranger District and along the East Rim break in Saddle Mountain Wilderness on the North Kaibab Ranger District. Gambel oak shrublands make up less than 0.3 percent of the Kaibab NF and total approximately 5,370 acres.

Desired Conditions for Gambel Oak Shrublands

- The system is dominated by native tall shrubs and hardwood trees. Some areas contain many trees with relatively large hollow boles or limbs. Coniferous trees are widely scattered and are frequently mature or old. Young Gambel oak thickets and sometimes other species comprise a patchy shrub layer.
- Ground cover is mostly comprised of oak litter, with grasses and forbs present.
- Low-intensity fire occurs regularly in intervals of less than 25 years.

- Old stands contain habitat for birds and arboreal nesting or roosting mammals. A variety of oak growth forms, sizes, and densities that benefit wildlife species can be found across the landscape.

Management Approach for Gambel Oak Shrublands

Gambel oak may be managed to increase hard mast production, cavities, and deciduous foliage volume to promote and enhance wildlife habitat. Potential activities include thinning encroaching conifers and low-intensity fire to kill stems less than 6 inches d.b.h.

Wetland/Cienega

The wetland/cienega vegetation communities are associated with perennial springs or headwater streams where groundwater intersects the surface and creates pools of standing water, sometimes with channels flowing between pools. Soils are often saline. Riparian vegetation occurs in wet areas and ranges widely depending on amount, timing, and water source, as well as biophysical characteristics (e.g. gradients in saturated soils and salinity). Some vegetation types found in saline areas of wetlands/cienegas include salt grass (*Distichlis spicata*), yerba mansa (*Anemopsis californica*), and sacaton (*Sporobolus* spp). Pools and saturated soils support rushes (*Juncus* spp.), sedges (*Carex* spp.), flat sedges (*Cyperus* spp.), spike rushes (*Eleocharis* spp.), and other aquatic vegetation. Wetlands/cienegas have historic and contemporary significance to area tribes due to the cultural value of water and because they contain traditionally used resources that are rare on the landscape.

On the Kaibab NF, wetlands/cienegas primarily occur as ephemeral wetlands at elevations ranging from 5,900 to 9,500 feet, but also occur in high elevation (up to 11,000 feet) meadows with subsurface flows dominated by herbaceous cover. Historically, this vegetation community would have had less than 10 percent tree canopy cover.

Ephemeral wetlands contain standing water for a portion of the year (typically from snowmelt in years when precipitation is normal to above normal) and are dry for a portion of the year. They provide important resting habitat during spring migration. They cover about 1,500 acres on the North Kaibab and Williams Ranger Districts, and include landmarks such as Davenport, Dry, and Duck Lakes on the Williams Ranger District.

Drought and flooding are the primary natural disturbances. Fire is an infrequent disturbance and enters from adjacent vegetation types.

Desired Conditions for Wetlands/Cienegas

- Wetland conditions are consistent with their flood regime and flood potential.
- Native plant and animal species that require wetland habitats have healthy populations within the natural constraints of the particular wetland community.
- Wetlands infiltrate water, recycle nutrients, resist erosion, and function properly.

Objectives for Wetlands/Cienegas

- Restore native vegetation and natural water flow patterns on at least 6 acres of wetlands within 5 years of plan approval.

Management Approach for Wetlands/Cienegas

Standing water and vegetation in wetlands may barely exist in dry periods, but during wet periods these communities can be highly productive. Because tree encroachment and high tree density of adjacent vegetation types can lower the water table and reduce water flow, vegetation management can be an effective strategy for increasing water flow into these systems.

See also “Natural Waters.”

Cottonwood-Willow Riparian Forest

Southwestern riparian ecosystems—which include ephemeral, intermittent, and perennial streams and rivers—are ecologically dynamic habitats characterized by linear patches of vegetation. Riparian systems have decreased in size over the past 100 years, largely as a result of human development. In the West, factors such as livestock grazing, beaver extirpation, and road development are commonly attributed to the loss of riparian habitat. Riparian areas are considered one of the most important habitat types for Arizona and the Southwest. Activities such as channelization and river diversion, domestic livestock grazing, timber harvest, invasive species colonization, recreation, and infrastructure development have led to a 90 percent reduction of this habitat type in Arizona and New Mexico, compared to historic (prior to 1890) conditions.

Cottonwood-willow riparian forests are characterized by dense groves of low, shrublike trees or tall shrubs to woodlands of small to medium and large sized trees. This vegetation type is found adjacent to permanent surface water, such as streams and springs, and in places where shallow ground water is consistently available. Usually an abrupt transition occurs between this and adjacent shorter and more open desert vegetation communities.

Riparian vegetation height depends on constituent plant species. Willow (*Salix* spp.) thickets range from 3 to 10 feet (1 to 3 meters) in height while Fremont cottonwoods (*Populus fremontii*) may exceed 80 feet (24 meters). Plant species vary and may exist as a variety of structural stages ranging from seedlings through tree/shrub to large tree. Vegetation within this community is predominantly composed of deciduous species. Common native trees and shrubs, depending on location and elevation, include narrowleaf cottonwood (*Populus angustifolia*), box-elder (*Acer negundo*), bigtooth maple (*Acer grandidentatum*), Rocky Mountain maple (*Acer glabrum*), water birch (*Betula occidentalis*), aspen, thin-leaf alder (*Alnus tenuifolia*), New Mexico locust, Scouler willow (*Salix scouleriana*), and arroyo willows (*Salix lasiolepis*). Canopy development and plant density depend on available water, plant species, and site characteristics. Soils vary from silty alluvial to rocky, sandy, well-drained substrates. Hot, dry summers, and cool to cold, moist winters characterize this vegetation type.

On the Kaibab NF, this vegetation community is located only within Kanab Creek Wilderness at elevations ranging from 3,200 to 4,500 feet and covers approximately 1,200 acres. It evolved with flooding as a major natural disturbance. Upstream diversions, impoundments, and tamarisk (*Tamarix ramosissima*) invasion has resulted in departures from the historic flooding regime. As a result, this vegetation community on the Kaibab NF does not typically occur in patches large enough to be considered a “forest.”

Desired Conditions for Cottonwood-willow Riparian Forest

- The extent, diversity, and condition of riparian habitat contribute to ecological sustainability. Dense shrubbery and high levels of vegetative diversity (structural and compositional) and permanent water provide food, cover, and water for wildlife, including terrestrial and aquatic invertebrates and vertebrates.
- Vegetation is characterized by willow and other herbaceous understory species. Snag and gallery tree components comprise 55 percent mid-aged to mature cottonwood and willow trees, 25 percent younger trees and 20 percent in grass, forbs, shrubs, suckers, seedlings, and tree sprouts.

- Vegetation is structurally diverse and provides habitat for high bird species diversity and abundance with nesting and foraging opportunities for neotropical migrant birds.
- Mature cottonwood and other trees provide cavities for cavity dependent wildlife such as woodpeckers, sapsuckers, and secondary cavity users.
- Tall trees provide lookouts and opportunities for nesting raptors.
- Water flow regime approximates reference conditions (i.e., perennial flows) and flows freely. Sedimentation is minimized. Springtime flooding contributes to ecosystem sustainability by optimizing germination conditions for seedlings and/or suckering opportunities from the parent plant.
- Native vegetation dominates, but when nonnative vegetation is present, the spatial and structural composition contributes to overall faunal diversity.
- Grazing from domestic ungulates is minimal or absent.
- Soil is free from compaction and includes sand and gravelly reaches and provides suitable germination sites for desirable plant species.
- Sandy and vegetated terraces provide habitat for reptiles and amphibians.
- Shallow exposed watersides provide drinking and foraging opportunities for wildlife.
- Fire is limited or absent in this system.

Management Approach for Cottonwood-willow Riparian Forests

The Kaibab NF recognizes the importance of riparian areas during project planning and implementation, and emphasizes their protection while managing them within multiple-use guidelines.

Program managers work with public affairs to communicate the ecological significance of these systems to the broader public and to garner support for restoration activities, which may facilitate increasing water into these systems. Restoration activities may also include burning and/or mechanical removal of invasive non-native species (tamarisk, Russian olive (*Elaeagnus angustifolia*)) followed by herbicide treatments (if necessary) and active revegetation of desirable species. The recent arrival of tamarisk beetles (*Diorhabda elongate*) on the Kaibab NF (originally introduced off-Forest as a biological control agent) may call for active burning and planting of native species following tamarisk mortality to make progress toward desired conditions. Increased capacity and broad support may be gained through partnerships. Work with various stakeholders, including the Kaibab Band of Paiute Tribe to restore cottonwood-willow riparian vegetation communities.

Soils and Watersheds

Soil and watershed condition is integral to all aspects of resource management and use. Good watershed management maintains the productive capacity of soils, protects water quality and quantity, sustains native species, provides beneficial uses, and reduces the threat of flood damage to Forest Service infrastructure and downstream values.

On the Kaibab NF, there are 127 6th-level hydrologic unit code (HUC) watersheds. Roughly two-thirds of these are in fair to excellent condition. Watershed conditions have been generally static over the last 20 years. Some portions of watersheds have been improved through tree thinning

and managed fires while forest density in other areas continues to increase. The primary risk to watersheds on the Kaibab NF is uncharacteristic fire. Watersheds containing departed vegetation types are at higher risk of erosion, sedimentation, and nonnative species invasion following uncharacteristic fire, as well as a downstream risk of sedimentation.

Desired Conditions for Soils

- Soils provide for diverse native plant species. Vegetative ground cover is well distributed across the soil surface to promote nutrient cycling and water infiltration.
- Accelerated soil loss is minimal, especially on sensitive or highly erodible sites.
- Soils can readily absorb, store, and transmit water vertically and horizontally; accept, hold, and release nutrients; and resist erosion.
- Infiltration rates are good in TES soil units that are described as well drained and moderately well drained.
- Logs and other woody materials are distributed across the surface to maintain soil productivity.
- Biological soil crusts (mosses, lichens, algae, liverworts) are stable or increasing in semi-desert grasslands, desert, pinyon-juniper, and sagebrush communities.
- Soils are free from anthropogenic contaminants that could alter ecosystem integrity or affect public health.

Desired Conditions for Watersheds

- Vegetation conditions within watersheds contribute to downstream water quality and quantity. Surface runoff, sheet, rill, and gully erosion, and subsequent sedimentation into connecting waters downstream is minimal.
- Flooding maintains normal stream characteristics (e.g., water transport, sediment, woody material) and dimensions (e.g., bankfull width, depth, slope, and sinuosity). Vertical down cutting and embeddedness are absent in drainages.
- Flood plains are functioning and lessen the impacts of floods on human safety, health, and welfare.
- The fuels composition within watersheds does not put the watersheds at risk for uncharacteristic disturbance.
- Water quality meets or surpasses State of Arizona or Environmental Protection Agency water quality standards for designated uses. Water quality meets critical needs of aquatic species.

Guidelines for Soils and Watershed Management

- Projects should incorporate the national best management practices for water quality management and include design features to protect and improve watershed condition.
- In disturbed areas, erosion control measures should be implemented to improve soil conditions.

- Seeds and plants used for revegetation should originate from the same PNVT and general ecoregion (i.e. southern Colorado Plateau) as the project area.

Management Approach for Soils and Watersheds

Watershed protection was one of the primary reasons for establishing the national forests. Forested lands absorb precipitation, refill regional underground aquifers, sustain watershed stability and resilience, and provide aquatic and wildlife habitat. On the Kaibab NF, the highest risk to watersheds is uncharacteristic wildfire. Projects that reduce this risk and restore the natural vegetative and fuels composition also restore watersheds. As a result, the Kaibab NF uses an integrated management approach to make progress toward the soil and watershed desired conditions. Objectives to address these needs are found in the "Major Vegetation Community Types," "Nonnative Invasive Species," and "Natural Waters" sections of this plan. With these and other activities, the Kaibab NF generally employs best management practices before, during, and after activities to reduce or eliminate adverse effects.

The priority watersheds for restoration were identified on the Kaibab NF using the Watershed Condition Classification guide. The top six priority watersheds are Cataract Creek Headwaters, Coconino Wash Headwaters, Upper Hell Canyon, Upper Spring Valley Wash, Rock Canyon, and Slide Canyon. These priorities are expected to change over time with changed conditions and new information.

Natural Waters

Streams, springs, groundwater, and other natural waters are centers of high biological diversity in arid landscapes, and the ecological health of these resources is important for forest ecosystem sustainability. Wildlife is more concentrated around open water sources than in the general landscape, and obligate aquatic and semiaquatic species on the Kaibab NF are sometimes entirely dependent on these limited and scattered water sources. Collectively, these resources contribute to connectivity for wildlife across the landscape. Springs are highly productive habitats in otherwise low productivity arid landscapes. Springs are frequently more stable ecologically than surrounding upland ecosystems in arid regions, and may offer biological refugia for some species, particularly those that are narrowly endemic.

Natural waters provide water and food resources that are especially vital to wildlife; particularly birds, bats, and invertebrates. Springs have important traditional cultural significance to humans inhabiting arid landscapes. Contemporary uses include contributions to potable local and urban water supplies and agricultural uses such as livestock watering. These uses are vital to domestic and commercial interests in and around the Kaibab NF. In addition, springs provide cultural and recreational opportunities.

Desired Conditions for Natural Waters

- Stream channel stability and aquatic habitats retain their inherent resilience to disturbances and climate fluctuations. Stream channel morphology reflects changes in the hydrological balance, runoff, and sediment supply appropriate to the landscape setting.
- Springs and ponds have the necessary soil, water, and vegetation attributes to be healthy and functioning. Water levels, flow patterns, groundwater recharge rates, and geochemistry are similar to reference conditions. Springs, streams, and ponds have appropriate plant cover to protect banks and shorelines from excessive erosion.
- Hydrophytes and emergent vegetation exist in patterns of natural abundance in wetlands and springs in levels that reflect climatic conditions. Overhanging vegetation and floating plants such as water lilies exist where they naturally occur.
- The necessary physical and biological components, including cover, forage, water, microclimate, and nesting/breeding habitat, provide habitat for a diverse community of plant and wildlife species.
- Riparian dependent plant and animal species are self-sustaining and occur in natural patterns of abundance and distribution. Within its capability, stream flow and water quality are adequate to maintain aquatic habitat and water sources for native and desired nonnative species.[7] Native macroinvertebrates are appropriately abundant and diverse.
- Native amphibians are free from or minimally impacted by nonnative predation and diseases. Unwanted nonnative species do not exert a detectable impact on aquatic and wetland ecosystems
- Where springs or other natural waters have been modified for livestock and/or human consumption, developments are operational.
- The location and status of springs and water resources are known, organized, and available.

Objectives for Natural Waters

- Protect and/or restore at least 10 individual springs within 5 years of plan approval.

Guidelines for Activities In and Around Natural Waters

- Access to natural waters should be restricted to designated trails and points of entry to mediate erosion and prevent trampling and inadvertent introduction of nonnative and undesirable biota and disease.
- Activities in and around waters should use decontamination procedures to prevent the spread of chytrid fungus.
- Fences constructed around natural waters should allow bats and other desirable wildlife to pass through unharmed.

[7] Desirable non-native species are those with high social or economic value.

- Diversions of water sources that recharge wetlands should be assessed and appropriate actions should be identified to mitigate or minimize effects.
- Spring source areas should be preferentially protected.
- Forest springs information should be maintained in a database that facilitates long-term archiving, easy data entry, and comparison with monitoring results.
- Water rights for springs should be secured where there are no existing water rights or claims.
- The impacts of management activities on springs, streams, and wetlands should be evaluated and minimized.

Management Approach for Natural Waters

Due to the limited information available, Kaibab NF efforts and emphasis are placed on improving knowledge on the distribution of water resources and aquatic or wetland biota, resource protection, and rehabilitation of springs, including groundwater flow and geochemical analyses. Potential management activities include fencing or other physical protections, restoration of diversions, and revegetation with native species.

Develop collaborative strategies and partnerships for spring inventory, assessment, restoration, monitoring, and research when appropriate. Use volunteers to maintain and improve fence exclosures and decrease agency maintenance costs.

The Forest Service and Arizona Department of Environmental Quality (ADEQ) share the common objective of improving and protecting the nation's waters. ADEQ serves as the designated management agency within the context of the Arizona Water Quality Management Program for all NFS lands within Arizona. The Kaibab NF coordinates with ADEQ to ensure Forest Service projects meet the requirements of State Water Quality Management Plans and the Nonpoint Source Management Program developed pursuant to Federal regulations and the Clean Water Act.

To meet common objectives, the Kaibab NF works with partners and stakeholders (i.e., Museum of Northern Arizona, Grand Canyon Wildlands Council, The Nature Conservancy, Grand Canyon Trust , National Park Service (NPS), AGFD, and USFWS) to develop a Geographic Information System (GIS) layer of northern Arizona springs and seeps. The Kaibab NF also collaborates with stakeholders and uses public education and outreach to garner support for spring restoration.

See also "Wetland/Cienega" vegetation type

Constructed Waters

Various water impoundments have been constructed on the Kaibab NF for a variety of purposes including reservoirs, constructed lakes, stock tanks, and wildlife drinkers. Some constructed waters provide unique riparian habitats and recreation opportunities.

Desired Conditions for Constructed Waters

- Drinkers have escape ramps that provide safe access and egress for wildlife.
- Constructed waters do not contribute to the spread of chytrid fungus or unwanted nonnative species.
- Reservoirs maintain high water quality for parameters such as temperature, pH, and dissolved oxygen, and water levels are within the seasonal range of variable conditions.
- Artificial waters do not concentrate ungulate use in aspen stands.
- Desirable nonnative fish species provide recreational fishing opportunities in reservoirs and lakes consistent with the needs of native species.

Objectives for Constructed Waters

- Issue closure orders for prohibiting swimming and wading at Dogtown Reservoir and Kaibab, Cataract, and Whitehorse lakes within one year of plan approval.
- Issue a closure order for restricting foot and boat traffic in the northern part of Scholz Lake during waterfowl nesting season within one year of plan approval.

Guidelines for Activities In or Near Constructed Waters

- Swimming and wading is should not be allowed at Dogtown Reservoir, Kaibab, Cataract, or Whitehorse Lake.[8]
- During waterfowl nesting season, foot and boat traffic should be restricted in the northern part of Scholz Lake.[9]
- Scholz Lake should not be managed for recreational sport fishing.
- Current protocols for preventing the spread of chytrid fungus should be followed in riparian aquatic areas.
- If new waters are constructed, they should be located in areas that would reduce ungulate impact to sensitive vegetation or soils such as riparian, aspen, and wet meadow areas.
- Drinkers should be maintained to provide water during times of scarcity.

Management Approach for Constructed Waters

Work with the Arizona Game and Fish Department, grazing permittees, and sporting groups to manage constructed waters. Improve understanding of whether and how drinkers, tanks, and other constructed water features influence wildlife distribution and movement.

[8,9] Implementation and enforcement of these guidelines require closure orders.

Wildlife

The Kaibab NF provides habitat for a wide variety of wildlife species. Topographical and geological conditions, particularly between the South Zone (Williams and Tusayan Ranger Districts) and the North Kaibab Ranger District provide for variation in wildlife distribution and habitat use. The spatially disjunct nature of the three districts influences movement patterns of wide ranging mammal herds such as elk, mule deer, and pronghorn. The Kaibab NF is primarily responsible for providing habitat to maintain species diversity on national forest lands. The Forest Service has ultimate responsibility over NFS lands, but the AGFD and the USFWS are the lead agencies responsible for managing wildlife populations in Arizona. Specifically, USFWS works with the Forest Service on the management and recovery of threatened and endangered species, migratory birds, and bald and golden eagles (*Aquila chrysaetos*).

Desired Conditions for Wildlife

- Native wildlife species are distributed throughout their potential natural range. Desirable nonnative wildlife species are present and in balance with healthy, functioning ecosystems.
- Habitat is available at the appropriate spatial, temporal, compositional, and structural levels such that it provides adequate opportunity for breeding, feeding, nesting, and carrying out other critical life cycle needs for a variety of vertebrate and invertebrate species.
- Species with specific habitat needs (e.g. snags, logs, large trees, interlocking canopy, and cavities) are provided for.
- Grasses, forbs, and shrubs provide forage, cover, fawning, and nesting sites.
- Interconnected forest and grassland habitats allow for movement of wide ranging species and promote natural predator-prey relationships, particularly for strongly interactive species (e.g., mountain lions).
- Habitat configuration and availability allow wildlife populations to adjust their movements (e.g., seasonal migration, foraging, etc.) in response to climate change and promote genetic flow between wildlife populations.
- Human-wildlife conflicts are minimal. Hunting, fishing and other wildlife based recreation opportunities exist, but do not compromise species populations or habitat.

Guidelines for Wildlife

- Project activities and special uses should be designed and implemented to maintain refugia and critical life cycle needs of wildlife, particularly for raptors.
- Project activities and special uses should incorporate recommended measures for golden eagle management such as temporary closures to limit human disturbance in the vicinity of golden eagle nests.
- Potentially disturbing project-related activities should be restricted within 300 yards of active raptor nest sites between April 1 and August 15.

Management Approach for Wildlife

The Kaibab NF strives to create and maintain natural communities and habitats in the amounts, arrangements, and conditions capable of supporting viable populations of existing native and desired nonnative plant, aquatic, and wildlife species within the planning area while contributing to broader landscape-scale initiatives where appropriate. This is accomplished in an integrative fashion by working closely with range, fire, timber, and other resource areas to coordinate and maximize activities for wildlife benefit. Cooperation with State and federal wildlife management agencies also helps to minimize conflicting wildlife resource issues related to hunted, fished, and trapped species. The Kaibab NF coordinates with Rocky Mountain Research Station and other entities to identify future areas of research that would support management decisions and enable the adaptive management process.

The Kaibab NF continues to support the AGFD in various capacities directed toward managing wildlife, fish, and habitat. Areas for potential collaboration include (but are not limited to) achieving management goals and objectives specified in Arizona's State Wildlife Action Plan (SWAP), carrying out memoranda of understanding (MOUs) and the cooperative agreement for management of the Grand Canyon National Game Preserve, and management of recreation fisheries.

The Kaibab NF works closely with the BLM, Grand Canyon National Park, and AGFD in managing desert bighorn sheep, bison, and California condor (*Gymnogyps californianus*). Kaibab NF has been working and will continue to collaborative with the Arizona Wildlife Linkages Workgroup to implement strategies identified in the "Arizona Wildlife Linkages Assessment" as well as the "Coconino County Wildlife Corridor Assessment."

The Kaibab NF cooperates with State, Federal, and nongovernmental organizations to reestablish naturally occurring species that have been affected by anthropogenic activities. These include species such as the California condor and northern leopard frog (*Lithobates pipiens*), and where feasible and appropriate, the recovery and/or restoration of strongly interactive species within their historical range.

Potential climate change, drought, El Niño Southern Oscillation (ENSO), and the resulting potential effects of management activities are considered during project planning. Particular species that are sensitive to changes in weather may need special consideration. Changes in typical weather patterns can affect migration habitat use, breeding seasons, and fecundity (i.e., in hotter, drier years, mitigations may be needed to reduce physiological stress on breeding wildlife). Climate change is an important consideration when managing habitat for wildlife species.

The Kaibab NF references current literature and the best available science when making site specific decisions relevant to project planning. This is done in an interdisciplinary context with input from other

resource specialists. For example; the wildlife guideline specifying disturbance buffers around raptor nests is intended as a minimum buffer. Some raptor species (e.g., osprey) are more adapted to disturbance and are likely to tolerate a buffer of just 300 yards during the breeding season while other, less tolerant species (e.g. peregrine falcons (*Falco peregrinus*)) may require buffers of up to a ½ mile. Wildlife biologists work with other IDT resource specialists to identify and define the appropriate site specific buffers (within the context of plan guidance) for other raptors on a case-by-case basis.

Threatened, Endangered, and Sensitive Species

Threatened and endangered species are those listed under the Endangered Species Act of 1973. On the Kaibab NF, these species include the California condor, Mexican spotted owl, Apache trout (*Oncorhynchus apache*), and Fickeisen Plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*) at the time of plan implementation. Region 3 Sensitive Species[10] are those plants and animals identified by the Regional Forester for which population viability is a concern. The primary needs for threatened, endangered, and sensitive species (TES) are addressed through law, regulation, and policy (e.g., recovery plans and conservation agreements). As a result, this plan provides the framework for implementing the recommendations from these higher-level laws, regulations, policies, plans, and agreements for TES, with limited needed additional (below) direction.

Desired Conditions for Threatened, Endangered, and Sensitive Species

- Threatened, endangered, and sensitive species have quality habitat, stable or increasing populations, and are at low risk for extirpation.
- Goshawk nest areas are multi-aged forests dominated by large trees with interlocking crowns and are generally denser than the surrounding forest.

Guidelines for Threatened, Endangered, and Sensitive Species

- Project activities and special uses occurring within federally listed species habitat should integrate habitat management objectives and species protection measures from approved recovery plans.
- Project activities and special uses should be designed and implemented to maintain refugia and critical life cycle needs of Forest Service Sensitive Species.
- Activities occurring near areas used by bald eagles should follow recommendations identified in the National Bald Eagle Management Guidelines and Arizona Conservation Assessment and Strategy for the Bald Eagle.
- A minimum of six goshawk nest areas (known and replacement) should be located per territory. Nest and replacement nest areas should generally be located in drainages, at the base of slopes, and on northerly (NW to NE) aspects. Nest areas should generally be 25 to 30 acres in size.

[10] The Regional Forester's Sensitive Species List for the Southwestern Region can be found at http://www.fs.usda.gov/detail/r3/plants-animals/?cid=FSBDEV3_022105

- Goshawk PFAs (post-fledging family areas) of approximately 420 acres in size should be designated surrounding the nest sites.
- Potentially disturbing project-related activities should be minimized in occupied goshawk nest areas during nesting season of March 1 through September 30.

Management Approach for Threatened, Endangered, and Sensitive Species

The Kaibab NF maintains strong partnerships between the State, other federal agencies, academia, and nongovernment organizations to provide for TES species. Emphasis is placed on the protection and replacement of key habitats that contain threatened, endangered, and/or sensitive species of plants and animals. The Kaibab NF works with the USFWS and other partners to develop conservation measures (e.g. public education to reduce human impacts) to prevent listing and to aid to in the recovery and delisting of federally listed species. For 10(j) species, such as the California condor, this applies inside and outside the designated experimental range.

See also "Wildlife", "Natural Waters," "Caves, Karsts, and Mines," "Cliffs and Rocky Features," "Pediocactus Conservation Area," and "Arizona Bugbane Botanical Area."

Rare and Narrow Endemic Species

Some species face threats simply by virtue of their relatively limited distribution. Species (or subspecies) are considered to have a restricted distribution if they are limited in extent in the Southwest. A species is considered to be a rare and narrow endemic if it has extremely limited distribution and/or habitat in northern Arizona. Due to limited distributions and potential susceptibility to perturbations, some species may require specific management considerations. On the Kaibab NF there are currently 74 known species for which restricted distribution is considered a threat; of these, 48 are narrow endemics, some of which are on the Regional Forester's sensitive species list (see above).

Desired Conditions for Rare and Narrow Endemic Species

- Habitat and refugia are present for narrow endemics or species with restricted distributions and/or declining populations.
- Location and conditions of rare and narrow endemic species are known.

Guidelines for Rare and Narrow Endemic Species

- Project design should incorporate measures to protect and provide for rare and narrow endemic species where they are likely to occur.

Management Approach for Rare and Narrow Endemic Species

Species-specific information and management recommendations can be found in the Kaibab NF endemic species guidebook, which is to be maintained as a living document. This guidebook will be updated with new species, information, and locations as they become available.

See also "Wildlife," "Threatened, Endangered, and Sensitive Species," "Natural Waters," "Caves, Karsts, and Mines," "Cliffs and Rocky Features," "Pediocactus Conservation Area," and "Arizona Bugbane Botanical Area."

Nonnative Invasive Species

Some nonnative species have invasive tendencies and threaten native species, ecosystem function, and the quantity and quality of forest goods and services (e.g. noxious weeds). Some nonnative species are desirable and/or not likely to cause ecosystem disruption, and are not addressed in this section. The nonnative species with the highest treatment priority are bull thistle (*Cirsium vulgare*), cheatgrass (*Bromus tectorum*), Dalmatian toadflax (*Linaria dalmatica*), tamarisk (*Tamarix* sp.), and knapweeds (*Centaurea* sp.) (Russian (*C. repens*), diffuse (*C. diffusa*), and spotted (*C. maculosa*)), which have made significant increases in their overall population size in the plan area over the last 10 years. Leafy spurge (*Euphorbia esula*) and yellow starthistle (*Centaurea solstitialis*) are also of high treatment priority due to their invasiveness and tendency to outcompete native plants and form monocultures. Invasive weeds have been documented to alter soil temperature, soil salinity, water availability, nutrient cycles and availability, native seed germination, infiltration and runoff of precipitation, and fire severity and frequency. The alteration of physical conditions and disturbance regimes allow the invasive species to spread farther.

The Kaibab NF also has known populations of invasive animals including bullfrogs (*Rana catesbeiana*) and crayfish (*Cambarus* sp.). Similar to invasive plants, invasive animals have the potential to adversely affect native species and ecosystem function. They can out compete and prey upon native animal species, alter food web interactions, and impact native vegetation.

Desired Conditions for Nonnative Invasive Species

- Invasive species are contained and/or controlled so that they do not disrupt the structure or function of ecosystems or impact native wildlife.
- Visitor experiences are not adversely impacted by the presence of invasive species.

Guidelines for Nonnative Invasive Species

- All ground-disturbing projects should assess the risk of noxious weed invasion and incorporate measures to minimize the potential for the spread of noxious and invasive species. New populations should be detected early, monitored, and treated as soon as possible.
- Treatment approaches should use integrated pest management (IPM) practices to treat noxious and nonnative invasive species. IPM includes manual, biological, mechanical, and herbicide/pesticide treatments.
- Use of pesticides, herbicides, and biocontrol agents should minimize impacts on non-target flora and fauna.

Objectives for Nonnative Invasive Species

- Treat 2,000 to 3,000 acres invaded by nonnative invasive plants annually.

Management Approach for Nonnative Invasive Species

Strategies to prevent the spread of nonnative invasive species include education, inventory, and control guidelines. Educational programs that increase awareness are critical to effectively manage nonnative invasives. Treatments focus on those species that have the potential to permanently alter historical fire regimes or pose the greatest threat to biological diversity and watershed condition. To effectively manage invasive species populations, it is important to coordinate with other agencies, grazing permittees, and adjacent landowners in efforts for prevention and control.

While management that provides for interconnected habitats is desirable for many native wildlife species. In some circumstances such as springs, connectivity can also provide vectors for nonnative species to spread (e.g., water and vehicles used in fire suppression). The use of best management practices can minimize and prevent the spread of non-native invasive species.

See also "Wildlife", "Natural Waters," "Wildland Fire Management", "Rare and Narrow Endemic Species", "Wilderness", "Recommended Wilderness Areas".

Air Quality

The goal of air quality management is to meet human health standards, to meet visibility goals in areas of high scenic value, and to address and respond to other air quality concerns, such as nuisance smoke.

Human health standards are defined in the National Ambient Air Quality Standards (NAAQS) set by the Environmental Protection Agency (EPA) for seven pollutants considered harmful to public health: carbon monoxide, lead, nitrogen dioxide, particulate matter 10 microns in size or smaller (PM_{10}), particulate matter 2.5 microns in size or smaller ($PM_{2.5}$), ozone, and sulfur dioxide. Population centers with the potential to be impacted by management activities on the Kaibab NF are Sedona, Camp Verde, Flagstaff, Williams, Parks, and Tusayan. The Sedona/Camp Verde area is carefully monitored as it receives diurnal air drainage from the Prescott, Kaibab, and Coconino National Forests. To protect visibility in the national parks and wilderness areas of high scenic value, Congress designated all wilderness areas over 5,000 acres and all national parks over 6,000 acres as mandatory Federal Class I areas in 1977, subject to the visibility protection requirements in the Clean Air Act. The Class I areas most likely to be impacted by activities on the Kaibab NF are Grand Canyon National Park and Sycamore Canyon Wilderness.

EPA defines nuisance smoke as the amount of smoke in the ambient air that interferes with a right or privilege common to members of the public, including the use or enjoyment of public or private resources. Complaints of the odor or soiling effects of smoke, poor visibility, and impaired ability to breathe or other health-related effects are common examples. While no laws or regulations govern nuisance smoke, it effectively limits opportunities of land managers to use fire. Public outcry regarding nuisance smoke often occurs long before smoke exposures reach levels that violate NAAQS. The areas of particular concern for nuisance smoke from wildland

fire on the Kaibab NF are the Sedona/Verde Valley, Flagstaff, Williams, Parks, Tusayan, Grand Canyon National Park, and Sycamore Canyon Wilderness.

Coconino County enjoys good air quality. Few pollution sources, such as large metropolitan areas, industry, or power plants, exist in northern Arizona, which contributes to its reputation for clean air. Air quality in the air sheds the Kaibab NF shares with lands of other ownership experiences some impacts from emission sources and processes off Forest, such as pollution from distant metropolitan communities, or industrial activities on lands of other ownership. These impacts are outside the scope of forest management control.

Heavy equipment used on paved and unpaved roads during the implementation of projects has the potential to create localized impacts from fugitive dust. With high wind events, this fugitive dust has the potential to be carried for several kilometers.

Temporary decreases in air quality from management activities on the Kaibab NF are primarily from prescribed fires. Wildfires originating on the Kaibab NF also produce emissions. The NAAQS pollutant of concern from wildland fire is fine particulate matter, both PM_{10} and $PM_{2.5}$. Studies indicate that 90 percent of smoke particles emitted from wildland fires are PM_{10}, and about 90 percent of PM_{10} is $PM_{2.5.}$ Because of its small size, $PM_{2.5}$ has an especially long residence time in the atmosphere and penetrates deeply into the lungs.

Ozone is also a NAAQS pollutant. Levels are increasing and trending up in northern Arizona. Smoke from prescribed fires and wildfires may contribute to ozone formation under certain atmospheric conditions, but prescriptive criteria that land managers can use to minimize ozone creation do not yet exist.

The same fine particulate matter that poses health risks is also largely responsible for visibility impairment. The State of Arizona has developed a State implementation plan (ADEQ 2003) with long-term strategies to make “reasonable progress” in improving visibility in Class I areas inside the state and in neighboring jurisdictions,” and focuses on anthropogenic sources of emissions. Smoke and visibility impairment from wildland fire that closely mimics what would occur naturally is generally acceptable.

Federal agencies in Arizona fund a Smoke Management Group that is housed in the Arizona Department of Environmental Quality offices. This group assembles and coordinates planned burning activities from all Federal agencies on a daily basis, and works closely with officials in ADEQ to approve or disapprove prescribed fire activities to help ensure compliance with both health standards and visibility goals.

Much of the Kaibab NF is departed from its historic fire regime. By not burning periodically, accumulated fuels contribute to a greater amount of emissions when large uncharacteristic severe wildfires occur. Prescribed fires are implemented when ventilation conditions are favorable to reduce the concentration of emissions, and other emission-reduction techniques are used when feasible. They generally produce far fewer emissions than the uncharacteristic severe wildfires they are designed to deter because they burn primarily surface fuels, and not the forest canopy. On wildfires, burnout operations are used to protect values at risk by consuming fuels around them, to assist in confining the fire to the desired fire area, to modify fire intensity, and even to manage smoke production. On these wildfires, timing of burnout operations is often at the fire manager’s discretion, and they can also be performed when ventilation conditions are favorable. Over time, as fire reentry occurs, the reduced fuel load results in lower emissions per acre.

Desired Conditions for Air Quality

- Air quality meets or surpasses State and Federal ambient air quality standards.
- Management activities on the Kaibab NF do not adversely impact Class I airshed visibility as established in the Clean Air Act.

Guidelines for Air Quality

- Project design for prescribed fires and strategies for managing wildfires should incorporate as many emission reduction techniques as feasible, subject to economic, technical, safety criteria, and land management objectives.
- Decision documents, which define the objectives and document line officer approval of the strategies chosen for wildfires, should identify smoke sensitive receptors, and identify appropriate objectives and courses of action to minimize and mitigate impacts to those receptors.

Management Approach for Air Quality

Public tolerance for nuisance smoke, rather than law, regulation, or policy, effectively sets the social limit to the number of acres that can be treated with wildland fire. Community public relations and education, coupled with preburn notification, greatly improve public acceptance of fire management activities. In order to maintain public support for prescribed burns and the use of wildfires to accomplish resource benefits, it is important that land managers be responsive to the public's tolerance thresholds to balance ecological benefits with social and economic values. The public will tolerate several days of nuisance smoke in a row, and up to several weeks total a year, but even the most supportive have tolerance limits. Public acceptance of smoke varies greatly from year-to-year. Acceptance of smoke from prescribed fires and wildfires is high following seasons with high profile, high-severity events, and during extremely dry years when the threat of large, high-severity incidents is elevated. Conversely, acceptance wanes during wetter years when the threat of uncharacteristic fires is low.

Control measures developed for site specific projects can reduce these localized particulate matter emissions. Examples include reducing travel speeds on unpaved surfaces, ceasing work activities during periods of high winds, applying gravel or soil stabilizers on dust problem areas, covering loads, and covering ground surfaces with water during earth moving activities.

See also "Wildland Fire Management".

Caves, Karst, and Mines

Caves, karst, and mines provide habitat for many biota including bats, which require specialized niches for roosting and overwintering. Bats are important to cave ecosystems, especially large roosts. Cave ecosystems rely almost entirely on the surface for nutrients. As a result, bats deposit considerable amounts of surface nutrients into caves via guano. Because of this, the presence of bats can support an entire ecosystem. Consequently, cave-roosting bats are often considered keystone species. Eighteen bat species are known to regularly use caves in the American Southwest, and Arizona is home to all of these species. Many caves also have important

traditional cultural significance to area tribes. Due to these and other resource concerns, there are no caves on the Kaibab NF currently identified as appropriate for recreational activities.

Karst features are geological landforms that predominantly result from shaping process controlled by soluble bedrock, usually calceric in nature. Karst landscape is characterized by closed depressions, disappearing streams, and solutional shaping. Karst features create unique microhabitats and are important areas for rapid subsurface drainage and aquifer recharge.

Desired Conditions for Caves, Karst, and Mines

- Caves maintain moisture and temperature levels consistent with reference conditions.
- Archaeological, geological, and biological features of caves and mines are not disturbed by visitors.
- Caves, karst features, and abandoned mines provide quality habitat for bat species. Disease is within natural levels.
- Mine closures do not compromise habitat for species that require specialized niches for roosting and overwintering (e.g., bats).

Guidelines for Managing for Caves, Karst, and Mines

- Project design should include protections for subsurface geologic features to minimize disruptions to hydrogeology, cave microbiology and other aspects of cave ecology.
- When entering caves or mines, decontamination procedures should be followed for preventing the spread of white-nose syndrome (WNS; *Pseudogymnoascus destructans*).
- Caves containing endemic species should be managed for the protection of those species over other uses.
- Before closing caves or mines, they should be inspected to determine if bats are using these areas. If roost sites are present, closure structures such as wildlife friendly bat gates that meet the most current recommendations should allow bats to continue to use the cave or mine.

Management Approach for Caves, Karst, and Mines

Strategies to protect cave and karst resources include use of best management practices and site specific design features such as activity buffers that prevent silt, sediment and debris from flowing into karst features where they occur. The Kaibab NF references the Arizona National Forest Cave and Karst Management Plan, Appendix J - Karst Management, current literature, and the best available science when making site specific decisions relevant to project planning.

Currently, neither the cause nor the transmission of WNS is well understood; however, it is known that a cave or abandoned mine environment containing this fungus is infectious to hibernating bats. To ensure that management activities are using the best available information, the Kaibab NF has been collaborating with the USFWS, Bat Conservation International, AGFD, the National Speleological Society, and others to address conservation management for bat species, including the development of a response plan for WNS. A complete inventory of caves and associated endemic species may be needed on the Kaibab NF to inform management.

Additionally, strategies include working with public affairs, recreation, invasive species, cave and mine staffs; State and other Federal agency partners; and involved publics such as local caving groups to internally and externally increase WNS awareness at local and regional levels. Cave and karst management plans will be developed as needed to address resource concerns.

See also "Wildlife," "Threatened, Endangered, and Sensitive Species," and "Natural Waters"

Cliffs and Rocky Features

Cliffs and rocky features, which are common in the mountainous West, can be found across a wide elevation range that includes cool alpine landscapes to desert environments. Cliffs, rock outcrops, and talus slopes are unique habitats that increase topographic and biological diversity. On the Kaibab NF, these features provide important nesting habitat for California condors and peregrine falcons, and support numerous other wildlife and plant species including rare and narrow endemics. Recreational activities such as rock climbing, rock hounding, and mineral exploitation are also associated with these features.

Desired Conditions for Cliffs and Rocky Features

- Cliff ledges provide cover and nesting habitat for wildlife such as the American peregrine falcon, California condor, snakes, bats, birds, and small mammals.
- Rocks and rocky areas promote seedling germination and maintain cover for vertebrate and invertebrate species.
- Rock climbing and related recreational activities do not disrupt the life processes of rare or threatened species or diminish the function of specialized vegetation, such as mosses, lichens, and fleabanes.
- Rockslides and talus slopes are natural, undisturbed features that provide habitat for wildlife such as lizards, snakes, and land snails.

Guidelines for Activities On or Near Cliffs and Rocky Features

- Activities involving heavy machinery or blasting should minimize impacts to habitat associated with rocky features and cliffs.
- Near known active raptor nest sites, temporary closures and use restrictions should be implemented for rock climbing and other potentially disruptive activities.
- Where recreation activities have the potential to trample known populations of narrow and endemic plant species, signs should be posted educating the public to stay on designated trails and avoid impacts.
- Talus slopes should be surveyed for endemic species prior to authorizing quarrying, rock hounding, or construction activities that may alter them.

Management Approach for Cliffs and Rocky Features

In many cases, information on the rare and narrow endemics species that use cliffs and rocky features is lacking. Additional survey efforts and or targeted monitoring and research on life history and habitat needs may be needed to fill in those information gaps. Strategies include

working with academia, state and private forestry, rocky mountain research station and other groups. The forest also works with public affairs, recreation, invasive species; State and other Federal agency partners to educate the public on the importance of these features, especially for threatened, endangered and sensitive wildlife (e.g. California condor and peregrine falcon). The forest consults with the Rare and Narrow Endemic Guidebook to help identify design criteria and mitigation measures during project design and implementation.

Cultural Resources

The Kaibab NF is rich in historically and culturally significant resources. To date, approximately 30 percent of the Kaibab NF has been surveyed for cultural resources and over 9,600 historic properties have been identified and documented. These historic properties are related to a long history of human occupation and use of the Kaibab NF dating back at least 12,000 years. Such sites include preceramic lithic scatters associated with Archaic hunter-gatherers, pithouse and masonry structures associated with early farmers, historic sites related to Native American and early Anglo-European use of the area, numerous petroglyph and pictograph sites, and traditional cultural properties. Forty-four historic properties on the Kaibab NF have been listed to the National Register of Historic Places for their historic significance and more than 2,400 additional sites have been determined to be eligible for inclusion to the National Register.

Desired Conditions for Cultural Resources

- Cultural resources, including known traditional cultural properties, are preserved, protected, or restored.
- Historic artifacts are preserved in situ or, when necessary, curated following current standards.
- All historic properties are evaluated for their eligibility to the National Register and properties that are appropriate are listed to the National Register of Historic Places.
- Cultural resource findings will be synthesized and shared with the scientific community and public through formal presentations, publications, and educational venues.
- Public understanding about the cultural resources and historic preservation issues contribute to their protection.

The Kaibab NF historic documents, including photographs, maps, journals, and Forest Service program management records, are available to the public for research and interpretation. Objectives for Cultural Resource Management

- A “Passport in Time”[11] project is hosted every year.
- At least 20 interpretive presentations are provided to the public each year.

[11] Passport in Time (PIT) is a volunteer archaeology and historic preservation program of the USDA Forest Service. PIT volunteers work with professional Forest Service archaeologists and historians on national forests throughout the United States on activities such as archaeological survey and excavation, rock art restoration, surveys, archival research, historic structure restoration, oral history gathering, and analysis and curation of artifacts. For more information, visit: http://www.passportintime.com/.

- Non-project related cultural resource survey (Section 110 survey) is conducted in areas with a high likelihood of historic properties on at least 200 acres per year.

Standards for Cultural Resources Protection

- The purposeful excavation of human remains for educational purposes, such as research or field schools, is not permitted.

Guidelines for Cultural Resources Protection

- For archaeological projects with the potential to address the culture history of area tribes, the Kaibab NF should ensure that such projects address topics of known importance to tribes.

Management Approach for Cultural Resources Protection

The Kaibab NF has been working and will continue to work to identify, evaluate, and protect cultural resources. Collaborative partnerships and volunteer efforts that will assist the Kaibab NF in historic preservation will be developed and maintained. The Kaibab NF uses a proactive approach in protecting cultural resources from adverse impacts and conducts outreach to educate the public on the history of the area and historic preservation issues. Additionally, the Kaibab NF seeks opportunities to do additional survey beyond the stated objective of 200 acres per year when funding and other resources are available. Partnerships with federally recognized tribes help to protect ancestral sites and manage cultural resources through meaningful collaboration. The Kaibab NF recognizes that there are important tribal sacred sites, ethnographic resources and traditional use areas that may not meet the definition of a historic property. The Kaibab NF works to protect these resources using existing authorities in collaboration with federally recognized tribes. Memoranda of understanding with federally recognized tribes promote strong working relationships by addressing issues of mutual concern.

See also "Traditional and Cultural Uses," "Bill Williams Mountain Management Area," and "Red Butte Management Area" sections of this plan.

Traditional Cultural Properties

A traditional cultural property (TCP) is a type of historic property under the National Historic Preservation Act defined as "eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community." In northern Arizona, TCPs are predominantly, but not necessarily, associated with American Indian tribes or communities.

Desired Conditions for Traditional Cultural Properties

- Traditional practitioners have access to TCPs for ceremonial use and privacy to conduct ceremonies.
- TCPs are preserved, protected, or restored for their cultural importance and are generally free of impacts from other uses.
- The significant visual qualities of TCPs are preserved consistent with the TCP eligibility determination.
- Traditional use of TCPs by the associated cultural groups is accommodated.
- Confidential and/or sensitive information regarding TCPs is protected.

Guidelines for Traditional Cultural Properties

- Development of new facilities and commercial and recreational activities should be minimized in TCPs.
- Consultation with federally recognized tribes should be conducted for all proposed special use permits within TCPs.

Management Approach for Traditional Cultural Properties

In order to achieve and maintain the desired conditions for TCPs, the Kaibab NF continues to identify, evaluate, and protect TCPs and work with associated communities to collaboratively manage TCPs by developing programmatic agreements, management plans, memoranda of understanding, or other management tools. The Kaibab NF accommodates and facilitates traditional use of TCPs and other culturally important places (such as trails and springs) that are essential to maintaining the continuing cultural identity of associated communities. The Kaibab NF takes an active role in educating the public on the importance of TCPs and issues related to their management while protecting confidential and/or sensitive information regarding TCPs.

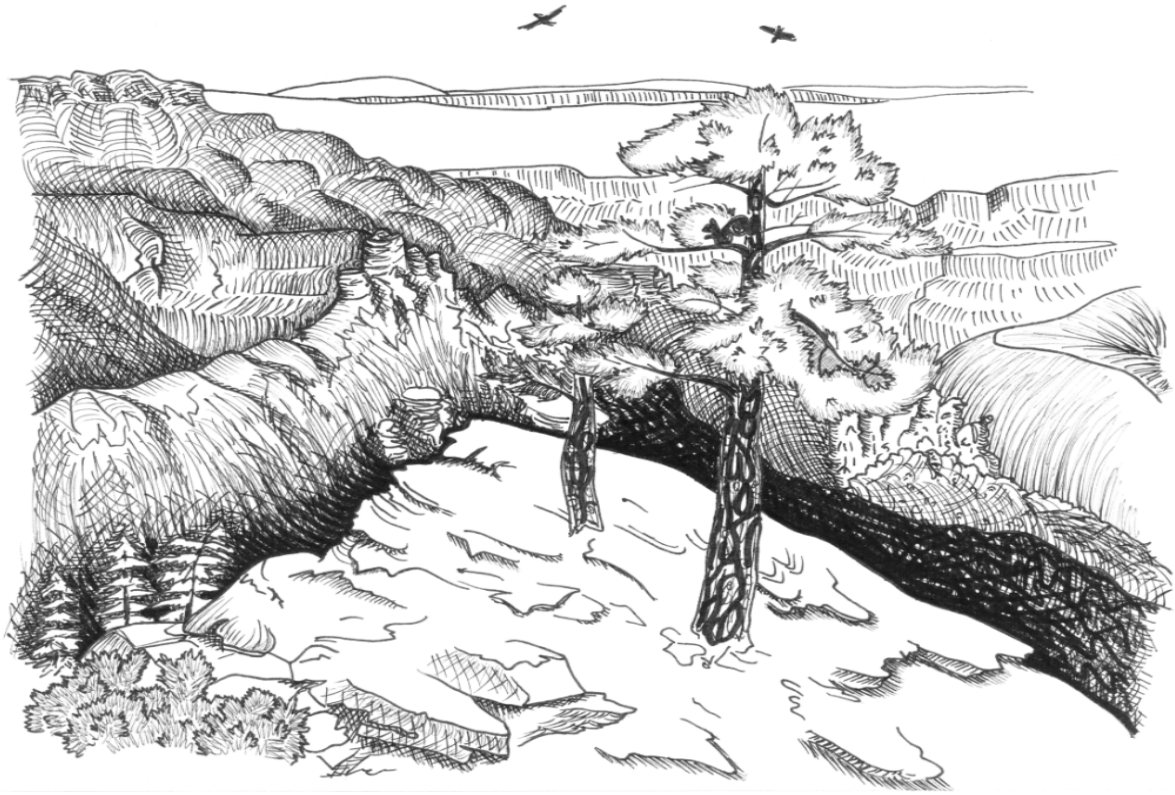
See also "Traditional and Cultural Uses," "Bill Williams Mountain Management Area," and "Red Butte Management Area" sections of this plan.

Forest Uses, Goods, and Services

National Forest System lands were reserved with the intent of providing multiple uses, goods, and services to satisfy public needs over the long term. The following sections describe the desired conditions and strategies for meeting this intent.

Recreation and Scenery

The natural, cultural, and scenic environments of the Kaibab NF offer settings for a wide range of high-quality recreation opportunities. The Kaibab NF provides quiet mountain, forested, and high desert places to escape from urban environments and to enjoy cooler temperatures. Cultural features provide historical context to the natural scenery, adding to the richness of the experience and sense of place. Scenic areas and associated outdoor recreation provide places to hike, bike, fish, hunt, view wildlife, drive for pleasure, and enjoy the peace, quiet, and spiritual values of nature. Forest landscapes, resources, and programs offer opportunities for education and engagement of children and adults alike. This facilitates an understanding of and participation in resource conservation and promotes knowledge and appreciation of the natural world and its relationship to human communities.



Desired Conditions for Recreation and Scenery

- A wide spectrum of high-quality recreation settings exists. Users have access to a variety of developed and dispersed opportunities.
- The Kaibab NF provides sustainable recreation consistent with public demand. Use levels are compatible with other resource values.
- Conservation education actively engages children and adults resulting in increased forest stewardship, ecological awareness, partnerships, and volunteerism. Information and educational programs provide opportunities to connect youth, low-income, and minority populations with nature.
- Visitors have access to information that enriches their recreation experiences and contributes to an understanding of their role in public land stewardship. "Leave No Trace,[12]" "Tread Lightly,[13]" fire prevention, wildlife awareness (e.g. lead reduction, Be Bear Aware[14], Animal Inn[15], etc.), and archaeological resource protection principles are promoted and practiced by the visiting public.
- Opportunities for off-highway vehicle (OHV) riding and driving for pleasure are available on the designated system of NFS roads and motorized trails.
- Recreation management activities complement and support local economies and tourism.
- User conflicts are infrequent.
- The Great Western Trail[16] route can be driven boundary to boundary through each of the districts where it occurs. Signage helps to identify and highlight the route.

The historic character of the Beale Wagon Road and Overland Road trails is preserved.The Kaibab NF provides both front country and back-country opportunities. The front country is composed of outdoor areas that are easily accessible by vehicle and heavily visited by day users. Front country locations include developed sites, tend to be more crowded, and attract a wider range of visitors than back-country areas. Recreation opportunity spectrum (ROS) classes of urban, rural, roaded natural, and roaded modified characterize front-country areas.

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[12] Leave No Trace" is a program that strives to educate all those who enjoy the outdoors about the nature of their recreational impacts as well as techniques to prevent and minimize such impacts.

[13] "Tread Lightly" is a program designed to "promote responsible outdoor recreation through ethics education and stewardship" (http://www.treadlightly.org). The program is framed under five principles: (1) travel responsibly; (2) respect the rights of others; (3) educate yourself; (4) avoid sensitive areas; and (5) do your part by modeling appropriate behavior, properly disposing of waste, etc.

[14] Be Bear Aware" is a program that to seeks to reduce human/wildlife conflicts and keep bears wild. It emphasizes education and safety techniques for avoiding encounters with bears.

[15] Animal Inn is a program that seeks to help people realize the critical value of dead, dying, and hollow trees for wildlife and fish and encourage them to save certain types of dead, dying, and hollow trees.

[16] The Great Western Trail is a long-distance, multiple use route that traverses over 4,000 miles from Mexico to Canada. On the Kaibab, all sections occur on roads that are open for morotorized travel.

Back-country recreational areas are more remote and are not as easily accessed as front-country areas. They are used primarily by overnight visitors. ROS classes of semiprimitive motorized, semiprimitive nonmotorized, primitive, roaded natural, and roaded modified designations characterize back-country areas. See chapter 4 for more information on recreation suitability and for ROS maps of the Kaibab NF.

Desired Conditions for Recreation – Front Country

- Front-country areas provide initial contact points for forest users and developed recreation settings where people can engage in a variety of recreation activities including scenic driving, hiking, camping, picnicking, fishing, and boating. Motorized and nonmotorized recreation opportunities are available.
- Recreation settings retain high to moderate scenic quality. Some human influenced elements in the background are present.
- Service centers such as district offices, visitor information centers, developed campgrounds, and other staffed recreation sites provide information and services in communities and along primary forest access corridors and scenic byways.
- Front-country areas are safe, orderly, and capable of supporting moderate to high visitor use.
- Formal interpretive programs and opportunities for self-guided nature study are provided.
- Constructed facilities in front-country settings provide for user comfort and resource protection. They blend in with the surrounding landscape and often incorporate naturally occurring or naturally appearing materials. The number and size of constructed facilities is appropriate for the use and activities that occur at each site.
- Developed campgrounds meet the needs of vehicle-based camping. The overall capacity of campgrounds meets demand at high-use seasons including large groups. Artificial and modified natural waters provide opportunities for fishing, picnicking, natural quiet, wildlife viewing, and, in some cases, for camping and boating.

Desired Conditions for Recreation – Backcountry

- Back-country areas are mostly undeveloped places where people engage in a variety of more primitive recreation activities. Visitors rely on their outdoor skills and provide their own equipment as they engage in recreation activities.
- Main access corridors to NFS lands and contact points such as developed trailheads and observation points have information available and provide a transition and orientation place for forest users as they enter back-country areas. Visitor use in these areas is moderate and disperses from these points.
- Facilities are few in number, use the minimum area needed, and have simple construction designs that blend in with the surrounding area. They are made of native materials or other well-matched materials. Constructed facilities provide for natural resource protection.
- Informal pullouts and minimal signing provide access to areas such as forest trails, scenic vistas, or wildlife viewing locations.
- Users have low to occasional contact with other visitors and Forest Service personnel.

- Visitors can find information on recreation opportunities in the area. Informal interpretive and educational information is available at secondary visitor contact points and focus on appropriate use of the Kaibab NF, incorporating natural and cultural resource conservation messages.
- Back-country recreation settings retain high to moderate scenic quality.
- Back-country areas provide opportunities for natural quiet and spiritual values.

Objectives for Activities Affecting Recreation and Scenery

- Issue closure orders to facilitate implementation and enforcement of the standards for recreation activities within one year of plan approval.

Standards for Recreation Activities[17].

- The maximum allowable occupancy of NFS lands within the Kaibab NF is 14 out of any 30 consecutive days, except as allowed by permit.
- Camping and campfires are not allowed at developed trailheads and day use sites.
- Areas within ½ mile of cabin rentals, developed campgrounds on the North Kaibab Ranger District, and the East Rim Overlook are closed to dispersed camping and campfires.
- Areas within one mile of developed campgrounds and cabin rentals on the Tusayan and Williams Districts are closed to dispersed camping and campfires.
- Tusayan RD prohibits camping on all NF lands within ¼ mile of the centerline of Hwy 64.
- Sledding devices used at the Oak Hill Snowplay Area must be constructed of soft materials (i.e. no metal, wood, or hard plastic).

Guidelines for Activities Affecting Recreation and Scenery

- Any new motorized trailheads should be located in front-country areas, incorporate or convert existing roads, protect open space, and protect natural and cultural resources.
- Group uses should be concentrated in front-country areas.
- Resource impacts should be reduced in front and back-country areas by directing camping to existing dispersed and designated campsites. New campsites are designated only when necessary to further reduce resource damage.
- Pack-it-in, pack-it-out practices should be used at dispersed sites.
- The “Kaibab NF Recreation Opportunity Spectrum and Scenery Management Handbook” (USDA 2004)[18] and “Built Environment Image Guide” should be used for recreation management and project design.

[17] Implementation and enforcement of these standards require closure orders.

- In areas with high scenic integrity objectives, only minimal alterations from landscape character goals should be allowed.
- In areas with moderate scenic integrity objectives, only slight alterations should be allowed, and they remain visually subordinate to the landscape character.

See also "Special Uses," "Transportation and Forest Access," "Recreation Suitability," "Developed Recreation Sites," and "Bill Williams Mountain Management Area".

Management Approach for Recreation and Scenery

Recreation management decisions on the Kaibab NF are guided by three primary approaches. These approaches are aimed at providing managers a more complete framework for considering management actions. Their purpose is to minimize new development in remote settings and to protect and manage both low and high use areas and facilities. These approaches guide actions in response to changing or increasing use.

Provide a range of recreation opportunities. Manage in a way that maximizes the opportunities available to all types of recreationists to the degree allowed by this plan and other agency regulations.

Concentrate use at specific sites or locations rather than dispersing use within the area or to other areas. In keeping with the principles of recreation ecology, this approach would assure that impacts associated with recreational use are constrained to particular areas.

Minimize the extent to which forest management actions disperse use from high to low use areas. This would help accomplish the goal of constraining the number and size of areas impacted by recreational use where possible.

The ultimate goal of these approaches is to maintain the visitors' perceived freedom to recreate how and where they choose, while retaining healthy, sustainable public lands. When impact and user capacity questions arise, indicators and standards to determine how and where to allocate visitor use should be employed. These approaches would not preclude the Kaibab NF from developing new sites or adapting old sites to accommodate new uses, provided appropriate analyses are conducted to make those decisions.

As the population in northern Arizona and the popularity of mountain biking and OHV use continues to grow, the pressure for more trails will likely increase. Any new trail development needs to strike a balance between opportunities for different types of recreation and other resource concerns. Due to the nature of motorized, equestrian, and bicycle trail use, regular maintenance is needed. Partners, volunteers, and potentially a fee system could help to provide increased capacity and revenue for maintenance materials, operation, education, and enforcement of regulations.

[18] The "Kaibab NF Recreation Opportunity Spectrum/Scenery Management System (ROS/SMS) Guidebook" (USDA 2004) provides detailed information about applying the Recreation Opportunity Spectrum in the management of outdoor recreation settings and the Scenery Management System and its related scenic integrity levels on the Kaibab NF.

Many forest users have expressed concerns about recreation use impacts and a desire for opportunities to engage in shared stewardship of the Kaibab NF. With limited Forest Service budgets and increased recreation pressure, volunteers and partners will likely play an increasingly important role in helping to construct and maintain trails and manage dispersed camping, especially at popular areas such as viewpoints.

The Kaibab NF places emphasis in its specific niches. As such, recreation opportunities on the North Kaibab Ranger District emphasize dispersed recreation, nonmotorized trail and wilderness opportunities, while on the Williams and Tusayan districts, the recreation emphasis is on day-use areas, developed recreation opportunities, and facilities such as campgrounds.

Traditional and Cultural Uses

The Kaibab NF recognizes that area tribes have cultural ties and knowledge about lands now managed by the Forest Service, and that they have important roles in stewardship of the land. Tribes with aboriginal territories and traditional ties to the land now administered by the Kaibab NF include the Havasupai Tribe, Hopi Tribe, Hualapai Tribe, Kaibab Band of Paiute Indians, Navajo Nation, Yavapai-Prescott Indian Tribe, and Pueblo of Zuni. The Kaibab NF shares boundaries with the Havasupai and Navajo Reservations and is in close proximity to numerous tribal communities. Tribal members visit the Kaibab NF to gather medicinal plants and for other traditional and cultural purposes. The Kaibab NF recognizes the importance to area tribes of maintaining these traditions and accommodates traditional use on NFS lands.

Desired Conditions for Traditional and Cultural Uses

- Traditionally used resources are not depleted and are available for future generations.
- Tribal members have access to sacred sites for individual and group prayer and traditional ceremonies and rituals. There are opportunities for solitude and privacy for ceremonial activities.
- Traditional uses such as the collection of medicinal plants and wild plant foods are valued as important uses.
- The Kaibab NF provides a setting for educating tribal youth in culture, history, and land stewardship, and for exchanging information between tribal elders and youth.

Guidelines for Traditional and Cultural Uses

- Activities and uses should be administered in a manner that is sensitive to traditional American Indian beliefs and cultural practices.
- The temporary closure authority should be used to accommodate traditional use.
- Tribal traditional use of medicinal plants and other botanical resources should take priority over applications for commercial harvesting.
- Important traditional use resources should be monitored to ensure healthy sustainable plant populations are available for traditional uses.

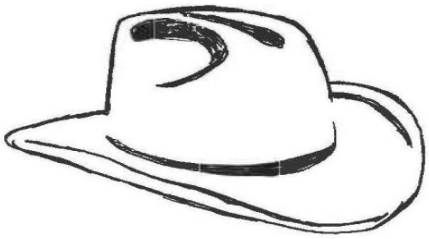
Management Approach for Traditional and Cultural Uses

Establishing and maintaining strong, mutually beneficial working relationships with tribes is critical to future success in addressing tribal issues related to land management. Tribal relationships and communication are strengthened through volunteer opportunities and employment of tribal members. Because all lands managed by the Kaibab NF were once tribal lands, the Kaibab NF uses a shared stewardship approach to land management based on meaningful consultations with area tribes. The Kaibab NF works to accommodate access and traditional use of resources and places of importance. The Kaibab NF and area tribes have a mutual interest in maintaining healthy, sustainable populations of plants and other resources important for traditional and cultural purposes.

The Kaibab NF continues to work with tribes to identify, collaboratively manage, and monitor these resources, as well as build and maintain more detailed information about culturally important plants. This would aid in ensuring that the physical integrity of resources and places of importance are balanced with the traditional use needs of tribes. The Kaibab NF works with tribes to protect the physical integrity of places of importance and balance the traditional use needs of tribes with the long-term protection of forest resources. The Kaibab and Coconino NF's Official Policy on "Forest Products for Traditional and Cultural Purposes" will help to provide consistent and clear direction across forest boundaries regarding traditional use.

See also "Traditional Cultural Properties" "Bill Williams Mountain Management Area," and "Red Butte Management Area" sections of this plan.

Livestock Grazing



Western lifestyles associated with ranching and livestock grazing have long been a part of the landscape. These historic and contemporary uses have become symbols of independence and contribute to the sense of place. Many people living in local communities participate in or have connections to ranching and identify with the associated values.

During World War II, Congress demanded as much protein production as possible from rangelands, and many areas were grazed unsustainably. The Kaibab NF made major reductions in authorized livestock from the 1950s through the 1970s in an effort to balance forage production with capacity. Further adjustments to grazing management have been made through site-specific NEPA analysis and decisions on all allotments. Currently, the Kaibab NF manages the range resource to balance livestock numbers with forage capacity.

Desired Conditions for Livestock Grazing

- There are opportunities to engage in ranching activities and graze livestock on NFS lands. These activities contribute to the stability and social, economic, and cultural aspects of rural communities.
- Grasses and forbs provide adequate forage for permitted livestock.
- Livestock use is consistent with other desired conditions.

- Allotment fencing allows for passage of animals susceptible to movement restrictions such as pronghorn.

Guidelines for Livestock Grazing

- Livestock management should favor the development of native cool season grasses and forbs.
- As grazing permits are waived back to the Kaibab NF, they should be evaluated for conversion to forage reserves to improve flexibility for restoring fire-adapted ecosystems and in response to other range and resource management needs.
- New construction and reconstruction of fences should have a barbless bottom wire that is at least 18 inches high.
- Annual operating instructions for livestock grazing permittees should ensure livestock numbers are balanced with capacity and address any relevant resource concerns (e.g., forage production, weeds, fawning habitat, soils, etc.).
- Grazing of domestic sheep and goats should not be authorized on the Tusayan and North Kaibab Ranger Districts due to the proximity of bighorn sheep in Grand Canyon and Kanab Creek to prevent the spread of disease between domestic and wild populations.
- Post-fire grazing should not be authorized until Forest Service range staff confirms range readiness.
- Livestock use in aspen areas should be authorized at levels that are consistent with the desired conditions for aspen regeneration and establishment.
- Livestock use in and around wetlands should be evaluated on an allotment specific basis. Mitigation measures such as deferment and fencing (full or partial) should be implemented as needed to minimize potential livestock effects.
- The concentrated use of montane meadows for livestock grazing should be minimized when soils are saturated to reduce grassland impacts. When no other options are available, use should be rotated annually.
- The term permit for the Rain Tank grazing allotment should be first offered to the Havasupai Tribe if one becomes available.

Management Approach for Livestock Grazing

The Kaibab NF uses an adaptive management strategy to manage the rangeland resources. Allotment management plans and associated grazing authorization decisions are made about every ten years following an environmental analysis in conformance with the National Environmental Policy Act (NEPA). In general, the Kaibab NF manages grazing at conservative use levels (30 to 40 percent). This grazing intensity (based on percent use of forage by weight) should provide for plant integrity, density, diversity, and regeneration over time. Grazing decisions involving new or modified fences, corrals, salt locations, and artificial water sources are designed to make progress towards the desired conditions in the plan and promote healthy soil and watershed conditions, wildlife interactions, and wildlife movement.

Within the scope of the NEPA grazing decisions, fine-tune adjustments are made annually through the annual operating instructions. Information from monitoring such as frequency plots, canopy cover, pace frequency transects, and allotment inspections inform appropriate adjustments. Grazing intensity (measured before the end of the growing season) in combination with other factors such as weather patterns, likelihood of plant regrowth, and previous years' utilization levels, is used in determinations. Authorized numbers may go up and down, but do not exceed the number set in the grazing decision, implemented through the term grazing permit. The annual operating instructions may also change season of use, salt locations, and pasture rest periods. Deferred-rotation grazing with deferment in the spring may be necessary to favor the development of native cool season grasses and make progress toward desired conditions.

See also the desired conditions for the relevant vegetation types, "Natural Waters," "Constructed Waters", "Caves, Karst and Mines" and "Wetland/Cienega."

Forestry and Forest Products

NFS lands were reserved with the intent of providing goods (including production of a sustainable supply of forest products) and services to satisfy public needs over the long term. The Forest Service focus has broadened over time, and the desired conditions for this plan are focused on outcomes rather than outputs. As a result, no specific timber volume outputs are desired for the Kaibab NF. Rather, timber production activities are tools that economically contribute to restoring and maintaining ecosystem diversity and supporting a viable wood products processing industry over the long term. Therefore, some level of regulated forest production is appropriate for forested lands.

Loss of the region's wood harvesting and utilization infrastructure has been a critical impediment to implementing large-scale mechanical thinning treatments necessary for prompt and effective restoration of fire-adapted forests. Although there are initial signs of emerging small-scale operations, development of a competitive market for the wood fiber removed by restoration-based treatment is needed. Without establishment of a viable industry, it is unlikely that forest restoration will occur on a scale that will produce the needed widespread improvements in ecological health or reduction in the risk of high severity wildfire.

Desired Conditions for Forestry and Forest Products

- Wood products (e.g., wood pellets for home and industrial heating, oriented strand board, animal bedding, wood moulding, pallets, structural lumber, firewood, posts, poles, biomass for electricity) and other products (e.g., Christmas trees, boughs, wildflowers, mushrooms, grasses, seeds, nuts, cones, etc.) are available to businesses and individuals in a manner that is consistent with other desired conditions on a sustainable basis within the capacity of the land.
- A sustainable supply of wood is available to support a wood harvesting and utilization industry of a size and diversity that can effectively and efficiently restore and maintain the desired conditions for ponderosa pine and frequent fire mixed conifer communities.
- Wood products are available to local tribes for traditional uses.

Standards for Forestry and Forest Products

- Regulated timber harvest only occurs on suitable lands.

Guidelines for Forestry and Forest Products

- Timber harvest activities should be carried out in a manner consistent with maintaining or making progress toward the desired conditions in this plan.
- Harvesting systems should be selected primarily for their ability to meet desired conditions and not on their ability to provide the greatest dollar return, although cost efficiency and practicality in terms of transportation and harvest requirements should also be considered.
- On suitable timber lands, even-aged stands should have reached or surpassed 95% of the culmination of mean annual increment prior to having a regeneration harvest, unless it is needed to reduce fire hazard within the wildland-urban interface, or would contribute toward achieving the desired uneven aged vegetation conditions over the long term.
- On lands classified as not suited for timber production, timber harvesting should only be used for making progress toward desired conditions or for salvage, sanitation, public health, or safety.

Guidelines for Personal Firewood Collection

The following should be permitted for personal use firewood gathering:

- Dead and downed ponderosa pine, Douglas-fir, white fir, spruce, juniper, pinyon pine, Gambel oak, and aspen.
- Standing dead ponderosa pine, Douglas-fir, white fir, or spruce less than 12 inches d.b.h. or less than 15 feet in total height.
- Standing dead juniper without green foliage Pinyon pine less than 12 inches diameter at root collar (d.r.c.) or less than 12 feet in height Gambel oak less than 8 inches d.r.c.
- Standing dead aspen less than 12 inches d.b.h. Live trees specifically designated by the Forest Service.

Management Approach for Forestry and Forest Products

On lands classified as suitable for timber production, mechanical tree removal and prescribed fire are needed to effectively make progress toward the desired conditions and are intended to retain characteristics of desired conditions for at least 20 years. In terms of prescriptions, this means that the post-treatment conditions may need to be on the more open end of the desired range to accommodate the growth that is anticipated in the interval between treatments. Within a given project boundary, some acres may be left untreated if they are already approaching desired conditions, or to provide for specific habitat needs as long as it would not affect desirable fire behavior at the mid-scale.

The objectives in this plan would mechanically thin 11,000 to 19,000 acres in ponderosa pine and 1,200 to 2,400 acres annually in the frequent fire mixed conifer type. This restoration work in ponderosa pine and frequent fire mixed conifer PNVTs is anticipated to be implemented using a combination of prescriptions to meet desired conditions including free thinning all sizes to a target basal area, group selection cuts with matrix thinning to a target basal area, individual tree selection, thin from below, and even-aged regeneration methods. Implementation of the proposed mechanical thinning treatments across the Kaibab NF would result in a significant supply of wood that could support a wood harvesting and utilization industry and help pay for treatments.

The amount of wood that is estimated to be available for sale from the suitable land within the plan area for the first decade of plan implementation is called the allowable sale quantity (ASQ). The ASQ is better described as the "average allowable sale quantity" because it may be exceeded in a given year as long as the 10-year average is not exceeded. For this plan, the ASQ is 107,815 CCF (hundred cubic feet).

Once the desired conditions are met, the amount of wood harvest that can be sustained from lands being managed for timber production under a specified management intensity consistent with multiple-use objectives is the long-term sustained yield (LTSY). The LTSY calculated for the proposed plan is 74,737 CCF.

Wildland Fire Management

The National Interagency Fire Center (NIFC) "Guidance for the Implementation of Federal Wildland Fire Management Policy" provides much of the current direction for managing wildland fire on Federal lands. This document provides definition of wildland fire used in this plan. Wildland fire describes any non-structure fire that occurs in the wildland. Wildland fires are categorized into two distinct types:

- Wildfires – Unplanned ignitions including human and naturally caused fires. These include prescribed fires that have been declared escaped wildfires.
- Prescribed fire – Planned ignitions.

Most of the Kaibab NF's vegetation is adapted to recurring wildfires started by lightning from spring and summer thunderstorms. Frequent, low-intensity fire plays a vital role in maintaining ecosystem health of much of the pinyon-juniper, ponderosa pine, and frequent fire mixed conifer vegetation types. These three vegetation types cover over 80 percent of the Kaibab NF. Grasslands are also adapted to frequent fire. Other vegetation types, such as pinyon-juniper-sagebrush, mesic mixed conifer, and spruce-fir, are also fire dependent, but have a historic fire regime of less frequent, mixed-severity fires.

The condition and structure of most of northern Arizona's forests, woodlands, shrublands, and grasslands have changed dramatically from reference conditions. Today, the Kaibab NF contains uncharacteristically dense forests with many more young trees than were present historically. Ponderosa pine, spruce, fir, juniper, and pinyon seedlings have invaded forest openings, grasslands, and savannahs. The forest and woodlands are deficient in grasses, forbs, and shrubs due to tree competition, and are at high risk for insect and disease outbreaks. With the denser more continuous

canopy cover and accumulated live and dead woody material, the probability and occurrence of large, uncharacteristic, stand-replacing fires continues to increase. These fires burn with more intensity, have higher tree and seed mortality, degrade watersheds, change soil chemistry, structure, nutrient availability, kill seeds,, and threaten homes and communities.

Entry with fire during appropriate weather and fuel moisture conditions is the most cost-effective way to reduce the likelihood of a high-severity fire. A single fire entry, with low to moderate fire behavior, reduces high-severity fire potential for 5 to 10 years in ponderosa pine and frequent fire mixed conifer and other vegetation communities in Fire Regime 1. With repeated fire entry within the historic fire frequency interval, the risk of a high-severity fire could be kept to a minimum indefinitely, except for a few days per year when fire danger indices are at their peak. To achieve a forest that is resilient to fire disturbance even during dry and windy conditions, forest structure needs to be more in line with desired conditions. In addition to treatment with fire, activities such as thinning and tree harvesting are needed to reduce tree density and canopy cover and promote the natural fire regime. Strategic placement and design more efficiently protects values at risk, given the limited resources and capacity to implement activities across the landscape.

Desired Conditions for Wildland Fire Management

- Wildland fire maintains and enhances resources and, as nearly as possible, is allowed to function in its natural ecological role.
- Regular fire entry protects social, economic, and ecological values at risk from high-severity disturbance effects.
- Wildland fires burn within the range of intensity and frequency of the historic fire regime of the vegetation community. Uncharacteristic high-severity fires rarely occur, and do not burn at the landscape scale.
- Wildland fire is understood, both internally and by the public, as a necessary natural disturbance process integral to the sustainability of the Kaibab NF's fire adapted vegetation communities.
- Information and education programs result in children and adults who recognize their responsibility for preventing human-caused wildfires.
- Wildfires are detected early.

Standards for Wildland Fire Management

- Initial action on human-caused wildfires will be to suppress the fire at the lowest cost with the fewest negative consequences with respect to firefighter and public safety.
- Managers will use a decision support process[19] to guide and document wildfire management decisions.

[19] The decision support system currently being used is the Wildland Fire Decision Support System (WFDSS).

Guidelines for Wildland Fire Management

- Decision documents, which define the objectives and document line officer approval of the strategies chosen for wildfires that progress past initial attack, should include interdisciplinary input to assess site-specific values at risk and develop incident objectives and courses of action to enhance or protect those values. At a minimum, the interdisciplinary team should:
    - Identify smoke sensitive receptors, and identify appropriate objectives and courses of action to minimize and mitigate impacts to those receptors.
    - Evaluate the risk of cheatgrass invasion. When there is a moderate to high risk of cheatgrass invasion, mitigation measures should be developed. If adequate treatments are not available, or if they are cost-prohibitive, objectives to minimize the burned area should be developed.
    - Develop objectives and courses of action to minimize fire-created openings to those within the reference range of variability for the vegetation community.
    - Develop objectives and courses of action to address the desired conditions for wildlife habitat and key habitat features such as snags, logs, large tree-form oaks, and oak thickets.
- If current or anticipated fire behavior and fire effects exceed the desired fire behavior and effects, protection objectives should be developed for wildfires, or a more conservative prescription window should be produced for prescribed burns. Strategies and tactics to mitigate those effects should be implemented on active wildland fires.
- Actively growing wildfires in the Desert Community vegetation type in Kanab Creek Wilderness should be suppressed, as this vegetation type is not known to be fire-adapted.
- Minimum Impact Suppression Tactics [20] should be used whenever they will successfully meet incident objectives, especially in the foreground of high scenic integrity areas.

Management Approach for Wildland Fire Management

Objectives for wildland fires may be developed based on fuel conditions, current and expected weather, current and expected fire behavior, topography, resource availability, and values at risk. Social understanding and tolerance may also affect objectives, as well as adjoining governmental jurisdictions having similar or differing missions and directives.

Wildfires may be concurrently managed for one or more objectives. Objectives can change as the fire spreads across the landscape; parts of a fire may be managed to meet protection objectives, while other parts are managed to maintain or enhance resources. Site specific analysis is conducted for prescribed fires and for any wildfire that extends beyond initial attack. For prescribed burns, the decision document is the signed NEPA decision. For wildfires, a Wildland Fire Decision Support System (WFDSS) analysis is performed, and signed by the appropriate line officer.

[20] Actionsto be considered that can minimize suprression impacts are listed in the “Interagency Response Pocket Guide” PMS-461, NFES1077, January 2010,but implementation may use more recent and/or local guidance.

In areas not highly departed from desired conditions, wildland fires may be managed to burn with the intensity and frequency of the reference fire regime when fire weather conditions are appropriate and resources are available to successfully meet objectives.

In areas moderately to highly departed from desired conditions, somewhat higher fire intensities and the associated fire effects may be acceptable or even desirable at the fine scale to move fire behavior toward desired conditions. Multiple small areas of high mortality are preferred over a single large, high-severity event.

Fire is one tool in the process of restoring the Kaibab NF's fire-adapted ecosystems; in areas departed from desired conditions the use of fire is most effective when combined with mechanical treatments that further restore forest structure. Mechanical treatments are costly, so the capacity to implement such treatments across the landscape is limited. Strategic placement and design of mechanical treatments increases their effectiveness in protecting values at risk.

In some areas, fire may be the only viable tool. Examples of such areas are steep rugged terrain where the high cost and hazards preclude mechanical treatment, or in remote areas of the Kaibab NF where the distance to high values does not justify the expenditure of limited funds and work capacity. Fire can be successfully used in these areas to treat NFS lands at the landscape scale and at a minimal cost. Objectives allowing for higher fire intensities and higher levels of mortality may be needed in these areas to achieve the structural change that will not occur through other means, and to move vegetation toward desired conditions.

Current and expected fire behavior provides the framework for developing objectives and strategies for wildfires. High confidence that fire behavior will be of lower intensity is supportive of the development of objectives and strategies to reduce fuel loading, and thereby reduce future risk of loss to a high severity incident. Current or expected high intensity fire behavior, or even uncertainty in the weather and future fire behavior, generally supports the development of protection-oriented objectives and suppression strategies. In the vicinity of high ecological values (e. g. North Canyon Creek, Arizona Bugbane Conservation Area, Kaibab Plains Pediocactus Conservation Area) or high social or economic values (e.g. WUI, TCP, Communication Sites), uncertainty in the forecast promotes conservative decision making with more protection oriented objectives and strategies.

Management of wildland fires is coordinated across jurisdictional boundaries whenever there is potential for managing a wildfire or a prescribed fire on more than one jurisdiction (e.g., Grand Canyon National Park, Coconino NF). This is done with the understanding that fire-adapted ecosystems span jurisdictional boundaries.

Fire prevention is also an integral part of the fire management program. The goal of the fire prevention program is to educate the public to reduce the number of potentially harmful human caused fires; project managers works with the prevention program to develop practices and protocols to reduce ignitions from management and recreational use.

See also Forestwide direction for each vegetation community type, "Livestock Grazing," "Air Quality," "Wildlife," "Wilderness", "Arizona Bugbane Botanical Area," "Pediocactus Conservation Area" and the "Wildland-urban Interface Areas."

Transportation and Forest Access

The Kaibab NF transportation system road network consists of thousands of miles of arterial, collector, local, and closed roads ranging from maintenance level 1 (closed to all motorized uses) to maintenance level 4 (smooth surface that provides a moderate degree of user comfort and convenience at moderate travel speeds). The road system provides access to areas on the Kaibab NF including private land, recreational opportunities, research sites, facilities, and to support forest and resource management.

Desired Conditions for Transportation and Forest Access

- Forest roads, bridges, and trails provide safe, legal, and reasonable access for recreation opportunities and resource management.
- Resource impacts from roads and trails are balanced with the benefits of having the road or trail available for use.
- High use, smooth surfaced roads provide safe access for low-clearance vehicles.
- Low use roads provide access for high-clearance vehicles.
- All designated routes open to wheeled motorized vehicles are shown on a motor vehicle use map (MVUM) that is readily available to the public.
- An adequate sign system exists to provide for traveler safety, location information, and compliance.
- The Kaibab NF has the road and trail rights-of-way needed to administer the Forest and provide public access.
- Roads and culverts do not contribute to headcuts or downcuts in ephemeral drainages.
- Roads allow for safe and healthy wildlife movement in areas of human development.
- Vehicular collisions with animals are rare.
- The inventoried roadless areas are free from activities that would alter their roadless character.

Objectives for the Transportation System

- Obliterate or naturalize[21] 20 miles of nonsystem roads (unauthorized, decommissioned, etc.) within 10 years of plan approval.
- Grade surfaces and clean culverts and ditches on 100 miles of open National Forest System roads each year.

[21] “Naturalizing” is a suite of techniques for restoring roads to a natural condition which may be either active orpassive (ripping, revegetating,etc.)

Standards for Transportation

- Motor vehicle use off the designated system of roads, trails, and areas is prohibited except as identified on the MVUMs and as authorized by law, permits, and orders in connection with resource management and public safety.

Guidelines for Transportation

- Motorized uses in semiprimitive nonmotorized areas should be restricted, except for necessary minimal administrative activities, permitted activities, and emergency access..
- Construction of permanent roads or temporary roads in semiprimitive nonmotorized areas should be avoided unless required by a valid permitted activity. If authorized, roads should be constructed and maintained at the lowest maintenance level needed for the intended use.
- Roads should not be located in meadows when they can be located in other areas.
- Roads should be decommissioned when no longer needed.
- Prior to road or trail construction in areas where subsurface geologic features are prominent, the proposed alignment should be surveyed for subsurface voids.
- Surveys should be conducted to assess wildlife use (bats, birds, etc.) and intensity before demolishing and/or modifying structures such as old bridges. If surveys determine that wildlife are actively using the structures, project design should include efforts to minimize impacts.

Management Approach for Transportation

In order to provide safe and efficient travel and support resource management on NFS lands, the Kaibab NF manages the Forest transportation system, conducts inventories, surveys and analyses, formulates plans, and executes reconstruction, maintenance, and obliteration operations. The transportation and facility management on the Kaibab NF is integrated with potentially affected resource areas and is coordinated with Federal, State, county, and other local transportation authorities. Best Management practices are used in project design. This includes working closely with the AGFD, Arizona Wildlife Linkages Working Group, and Arizona Department of Transportation (ADOT) to identify wildlife habitat needs, potential barriers to wildlife movement, and to mediate such threats during new projects by designing effective wildlife crossings and travel migration areas early in the transportation planning process.

Roads that serve year-round residents of inholdings are typically turned over to other public road agency jurisdictions. In cases where those agencies do not accept jurisdiction of the road, the Forest Service attempts to enter into road maintenance agreements to apportion the road maintenance according to the amount of use by each type of traffic. This results in some NFS roads being maintained by the county, homeowner association, Forest Service, or some combination thereof.

Potable Water

The Kaibab NF currently has 18 potable water systems. These include concessionaire operated, Forest Service operated, and systems on NFS land operating under a special use permit. Some of these systems are hauled water systems which receive water from other systems.

The City of Williams has the only municipal water system supplied by a watershed located on the Kaibab NF. The watershed is approximately 26,061 acres in size. Most (96 percent) of this watershed is within the Cataract Creek Headwaters and Dogtown Wash HUC12 subwatersheds. Citizens of Williams, Arizona, depend on this watershed as a source of public drinking water and for other benefits.

Desired Conditions for Potable Water

- Potable water systems are safe for human consumption.
- The City of Williams Municipal Watershed provides a reliable and treatable source of water.

Management Approach for Potable Water

To operate and maintain potable water systems that provide water to Kaibab NF facilities, the Forest Service often enters into agreements with partners (concessionaires, other agencies, or private entities). Both parties operate these systems jointly to ensure water quality standards are maintained. Strategies to better achieve the desired conditions include providing training to supervisors and certified water system operators, and conducting routine sanitary surveys, maintenance, and review of water quality from hauled sources.

Lands

The two primary functions of the lands program are the identification and maintenance of land line locations between NFS lands and lands of other ownership, and land adjustments. Land adjustments consolidate and improve management efficiency through real estate transactions including sales, purchases, exchanges, conveyances, and rights-of-way within the proclaimed Kaibab NF boundary.

Desired Conditions for Lands

- NFS lands exist in a pattern that promotes efficient management, which consists of large contiguous areas that provide efficient and effective resource management and wildlife connectivity within and across NFS lands.
- Lands identified for disposal and acquisition are displayed on the land adjustment map.
- The public has access to NFS lands within the Kaibab National Forest.

Objectives for Lands

- Obtain public access for all permanent roads and trails within the Kaibab NF boundary within 10 years of plan approval.

Management Approach for Lands

Work closely with the State, counties, and other Federal agencies to resolve rights-of-way issues and to ensure that public access to the various parts of the Kaibab NF on State, county or permanent NFS roads meets management objectives for all ownerships.

Work with adjacent landowners to minimize conflicts between public land users and private landowners. Resolve permanent legal public access issues by purchase, exchange, donation, and condemnation of rights-of-way.

Special Uses

Special use permits authorize the use and occupancy of NFS lands for activities and services. Permits are authorized when the proposed activities support the Forest Service mission, meet demonstrated public needs, and are consistent with the desired conditions for the use area. Permits are a partnership between the Forest Service and private businesses, academia, non-governmental organizations, or individuals to provide these services to the public.

Special uses are divided into two categories: recreation and lands. Recreation special uses include permitted activities related to resorts, ski areas, outfitter/guides, and recreation events. Lands special uses include communication sites, utility corridors, research permits, road access, and other non-recreational uses. Most of the direction for managing special uses is specified in the Forest Service directives (FSH and FSM).

Desired Conditions for Special Uses

- Special use permits support and contribute to the Kaibab NF and district niches.
- Permanent structures associated with special uses are concentrated on existing sites or designated corridors, minimizing the number of acres encumbered by special use authorizations.
- Special use activities blend into the landscape and do not draw attention to the activity or equipment.
- Permitted research promotes an understanding of ecological and socioeconomic systems on the Kaibab NF.

Recreation Special Uses

Recreation special uses on the Kaibab NF include permitted activities related to recreation such as resorts, ski areas, outfitter/guides, and recreation events.

Desired Conditions for Recreation Special Uses

- Recreation special uses are consistent with the Recreation and Scenery desired conditions of the forest plan.
- Outfitter/guide activities have a minimal impact on the experiences of other forest visitors.
- Recreation events are infrequent so they do not regularly impact the experience of local forest users.
- Existing recreation term permits such as golf courses, ski lodges, and resorts adequately serve forest visitors so that new ones are not needed.

Standards for Recreation Special Uses

- Competitive OHV and motorized events are not permitted on the Kaibab NF.

Guidelines for Lands Special Uses

- Uses should be combined to the extent possible in light of technical and environmental constraints.

Communication and Electronic Sites

Communication and electronic sites have been established (>10 sites) on the Kaibab NF as a legitimate use of NFS lands. These play an important role in ensuring good communications across northern Arizona and provide a critical link in national communication systems. Requests to use Federal lands for communication and electronic sites have increased over the past few years, and it is likely these types of special use permits will increase. Appendix F displays communication and electronic site locations on the Kaibab NF.

Desired Conditions for Communication and Electronic Sites

- Wildland fires do not interrupt the operation of communication and electronic facilities.

Guidelines for Communication and Electronic Sites

- New commercial communication sites should have a communication site management plan in place prior to the start of operations that is consistent with the Kaibab NF forest plan.
- The number of communication and electronic sites should be the minimal that is consistent with appropriate public services that require the use of Forest lands.
- Environmental disturbance should be minimized by co-locating communication and electronic sites.

Energy Transmission and Development

National emphasis on energy transmission and development is expected to grow. Requests to use Federal lands for energy development have rapidly increased over the past few years, and as the demand for alternative power sources continues to grow, it is likely these types of special use requests will increase. Most of the requests have been for energy transmission corridors, wind farms, and solar energy development. Most of the direction for the permitting process of energy transmission and development is conducted in accordance with the Forest Service policy for special use authorization and is not within the scope of this plan. Appendix F displays locations of major energy transmission corridors on the Kaibab NF.

Desired Conditions for Energy Transmission and Development

- Energy transmission and development on the Kaibab NF meets the legal mandates to facilitate the transmission and development of energy resources in a manner that minimizes adverse impacts and does not detract from meeting other desired conditions applicable to the area.
- Energy corridors provide a reliable supply of energy essential to meet local, regional, and national economic demands.
- Joint use of rights-of-way is provided to concentrate uses to the extent possible.
- Energy transmission lines are not visible (usually underground) across the landscape.
- Vegetative conditions and land uses within energy rights-of-way facilitate the operation and maintenance of the associated facilities and infrastructure. They may differ from the surrounding PNVT desired conditions in that they generally consist of low growing or non-woody vegetation.
- Wildland fires do not interrupt the delivery of energy resources within the rights-of-way.

Standards for Energy Transmission

- Major utility corridor development is confined to the area identified and mapped in the "West-wide Energy Corridor Programmatic EIS (USDOE and BLM 2008)."

Guidelines for Energy Transmission and Development

- Environmental disturbance should be minimized by co-locating pipelines, power lines, fiber optic lines, and associated infrastructure.
- Existing energy corridors should be used to their capacity with compatible upgraded power lines, before evaluating new routes.
- When compatible with protection of heritage resources, the use of below-ground utilities should be optimized in order to avoid potential conflicts with wildlife, scenery, wildfire, and long-term vegetative management.

Management Approach for Energy Transmission and Development

Work closely with the AGFD and Federal agencies to incorporate the Avian Powerline Interaction Committee for new and retrofitted powerlines

See also "West-wide Energy Corridor" management area.

Mineral and Mining Activities

Minerals of economic interest are classified as leasable, salable, or locatable. Coal, oil shale, oil and gas, phosphate, potash, sodium, geothermal resources, and all other minerals that may be acquired under the Mineral Leasing Act of 1920, as amended, are referred to as leasable minerals. Common varieties of sand, stone, gravel, pumicite, and clay that may be acquired under the Materials Act of 1947 are considered salable minerals or mineral materials. Minerals that are not salable or leasable, such as gold, silver, copper, tungsten, and uranium, are referred to as locatable minerals. Locatable mineral deposits include most metallic mineral deposits and certain nonmetallic and industrial minerals. Locatable minerals are subject to the General Mining Law of May 10, 1872, as amended, and for the most part are outside the scope of this plan.

Salable minerals on the Kaibab NF consist of sand and gravel deposits, building materials, and volcanic deposits such as cinders. Sand and gravel deposits exist but are relatively isolated within the North Kaibab and Tusayan Ranger Districts, and are mostly associated with the Moenkopi Formation and alluvial deposits. On the Williams Ranger District, gravel deposits have formed at the bottom of the southwestern slope of the Mogollon Rim. Building materials (primarily flagstone) are also widespread in this area and are associated with the Coconino Sandstone.

The commercial demand for saleable materials (e.g., flagstone, cinders, etc.) has decreased over the last few years with the downturn in the economy. As the economy recovers, the demand for construction products is expected to increase. Currently, there are no active mineral leases and no known coal, oil, or gas reserves on the Kaibab NF. The geological formations of the area do not favor such leasable mineral deposits, and the potential for oil, gas, or geothermal energy is low across the entire Kaibab NF.

All of the Tusayan and North Kaibab Ranger Districts and Kendrick Wilderness on the Williams Ranger District are withdrawn from locatable mineral entry. Existing mining claims in these areas may be developed where existing claims can prove valid existing rights. The locatable mineral deposits on the Williams Ranger District are associated entirely with stratabound deposits, which are small, and in today's economic climate are not commercially viable.

Desired Conditions for Mineral and Mining Activities

- Mineral and mining activities meet the legal mandates to facilitate the development of minerals on the Kaibab NF in a manner that minimizes adverse impacts to surface and groundwater resources, and that do not detract from meeting other desired conditions applicable to the area.

Standards for Mineral and Mining Activities[22]

- Surface use and occupancy is restricted within foreground[23] of heritage resource sites nominated or listed on the National Register of Historic Places.
- Construction of oil and gas well surface facilities within foreground of heritage resource sites with National Register status and in the visible foreground of State highways is not permitted.
- Oil and gas leases and plans of operation for exploration shall incorporate the following stipulation: "*Yearlong surface occupancy is not permitted in recreation, administrative and special use sites; on slopes of 15 percent or greater; and within foreground of all sites listed on the National Register*."

Guidelines for Mineral and Mining Activities

- Adverse surface impacts should be minimized through the appropriate administration of mining and mineral laws and regulations. Soil disturbance should be kept to a minimum.
- Restoration and reclamation of surface disturbance associated with mineral activities should be implemented to achieve 70 percent of ground cover (as compared to nearby undisturbed areas) with permanent native vegetation within three growing seasons.
- Surface use should be restricted or prohibited in areas with habitat for threatened, endangered, and sensitive plant and animal species, and for heritage resources nominated or listed on the National Register of Historic Places. Use and occupancy should be restricted yearlong in areas supporting populations of threatened, endangered, and sensitive plant species.
- On acquired lands where the Forest Service holds the mineral rights, leasable (hard rock) mineral activities that would remove more than 50 pounds of materials should not be permitted.

See also "Minerals and Energy Development Suitability."

[22] These standards retained direction from the original forest plan.

[23] Foreground is defined as the part of a scene, landscape, etc., which is nearest to the viewer, and in which detail is evident, usually one-quarter to one-half mile from the viewer.

Chapter 3: Management Areas

This chapter of the plan contains direction for management areas that have specific management direction that differs from the general forest. In some cases, there may appear to be a conflict between direction presented at larger and finer scales. If there is an apparent conflict, the direction at the finer scale takes precedence. There are two types of management areas:

Designated Areas are areas or features identified and managed to maintain their unique special character or purpose. Some categories of designated areas are designated by statute and some categories may be established administratively in the land management planning process or by other administrative processes of the Federal executive branch. Examples of statutorily designated areas are wilderness areas and national scenic trails. Examples of administratively designated areas are national scenic byways, national recreation trails, and botanical areas.

Management Areas (MAs) are delineated to provide plan direction for areas to meet specific management needs. They have a corresponding common set of plan components that differ from the general forest. Some management areas apply to more than one area on the Kaibab NF such as developed recreation sites, wildland-urban interface, and utility corridors. Other areas, such as Red Butte and Bill Williams Mountain are geographically specific.

Figures 2, 3 and 4 display designated areas and management areas on the North Kaibab, Tusayan, and Williams ranger districts, respectively.

Throughout this chapter, plan components (plan decisions) are displayed within text boxes. Text outside of boxes are background material, explanations, or descriptions of management approaches and are not plan decisions

Designated Areas

Wilderness

Designated wilderness provides places where natural processes dominate and the impacts of humans are minimized. Congress preserved these places to pass on to future generations. Wilderness provides large areas for the study of nature and unique scientific and educational opportunities. Wilderness areas are:

- "...lands designated for preservation and protection in their natural condition… " Section 2(a)
- "...an area where the earth and its community of life are untrammeled by man..." Section 2(c)
- "...an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvement or human habitation..." Section 2(c)
- "...generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable..." Section 2(c)
- "...outstanding opportunities for solitude or a primitive and unconfined type of recreation..." Section 2(c)

- "...shall be devoted to the public purposes of recreation, scenic, scientific, educational, conservation and historic use." Section 4(b)

(Wilderness Act of 1964 [Pub. L. 88-577])

Existing Wilderness on the Kaibab NF

Kendrick Mountain Wilderness

Kendrick Mountain Wilderness is a 6,660[24]-acre area that encompasses Kendrick Peak, one of the highest peaks in the San Francisco volcanic field. On the top of Kendrick Mountain there is a fire lookout tower, which predates wilderness designation. The lookout is important to the detection of wildland fires in the southern units of the Kaibab and northern part of the Coconino National Forest.

In 2000, most of the wilderness was burned in a large wildfire. Fire intensities ranged from light to very severe, with more intensely burned areas located on the west, north, and east slopes of the peak. Montane mixed conifer forests are present in the unburned and lightly burned areas. Natural recovery processes are occurring in more intensely burned areas, with aspen and other early seral species becoming established in those sites. Unstable volcanic soils have undergone severe erosion on the steeper slopes within burned areas.

The eastern part of Kendrick Mountain Wilderness lies on the Coconino National Forest, but this plan contains direction for the entire wilderness.

Kanab Creek Wilderness

Kanab Creek Wilderness is a 68,474-acre area on the north side of the Grand Canyon National Park. Most of the Kanab Creek Wilderness (91%) is managed by the Kaibab NF, with the remainder managed by the Arizona Strip District of the BLM. Kanab Creek is a major perennial tributary of the Colorado River, flowing from its source some 50 miles north in southern Utah. It cuts deep gorges and canyons into the walls of the Kanab and Kaibab Plateaus. The section of Kanab Creek on the Kaibab NF is listed eligible in the Nationwide River Inventory, with a potential classification as wild. Due to upstream diversions, most of the perennial flow in Kanab Creek is from groundwater discharge from springs that emerge in the middle reaches of the creek. Flooding from precipitation events remains a very important ecological process in Kanab Creek.

Elevations vary between 2,000 feet at the Colorado River to about 6,000 feet on the rim. The plateaus above are arid with sparse vegetation, while the canyon bottoms are comprised of riparian zones. Most of the slopes in this wilderness exceed 40 percent, and the canyon walls have been eroded into intricate sculptures of knobs, potholes, and fins in many places. The upper areas support desert bighorn sheep, mule deer, and almost all the chukar partridges (*Alectoris chukar*) in Arizona. The lower regions support numerous reptiles, snakes, birds, and lizards. Kanab Creek Wilderness contains the only desert community and cottonwood-willow vegetation communities on the Kaibab NF.

See also Forestwide direction for "Cottonwood-willow Riparian Forest" and "Desert Communities."

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[24] Management/designated area acreages may vary slightly over time due to factors such as resurvey, improved mapping technology, and updates to coprorate GIS layers.

Saddle Mountain Wilderness

Saddle Mountain Wilderness is a 41,115-acre area the straddles the eastern edge of the Kaibab Plateau. It is a rugged landscape of narrow drainage bottoms and steep scarps. The gentle slopes on the main ridge of the area drop dramatically to form the Nankoweap Rim on the south. Elevations range from about 6,000 feet on Marble Canyon Rim to about 8,000 feet on Saddle Mountain, a prominent ridge with a profile that resembles a saddle. Utah juniper (*Juniperus osteosperma*) and pinyon pine in the lowlands give way to mixed conifer in the highlands. The only perennial free-flowing stream on the Kaibab NF, North Canyon Creek, lies entirely within Saddle Mountain Wilderness. On the southern edge of the Wilderness, the gentle slopes on the ridge top drop dramatically to form the Nankoweap Rim, which marks the boundary with Grand Canyon National Park.

Sycamore Canyon Wilderness

Sycamore Canyon is the second largest canyon in the Arizona red rock country. The 21-mile-long scenic canyon reaches a maximum width of about 7 miles. Sycamore Canyon Wilderness is 58,408 acres and is a designated Class I Airshed. The Sycamore Canyon Wilderness is located on the Coconino, Kaibab, and Prescott National Forests, but the management direction for Sycamore Canyon Wilderness is contained in the Coconino National Forest Land and Resource Management Plan.

Desired Conditions for Wilderness Areas

- Wilderness provides opportunities for nonmotorized and non-mechanized primitive and unconfined recreation and contiguous wildlife habitat. Social encounters are infrequent and occur only with individuals or small parties.
- The environment is essentially unmodified. No services are provided and self-reliance is required. The naturally occurring scenery dominates the landscape. Manmade features are rare and use natural or complimentary materials. Some constructed features are present when needed to provide for public safety or resource protection.
- Enduring, high-quality wilderness values are maintained while providing for solitude and primitive, unconfined recreation experiences.
- Natural processes are maintained within wilderness. Fires function in their natural ecological role.
- Wilderness areas have minimal to no nonnative invasive species.
- Wilderness boundary postings are well maintained.
- Maps, information, and educational material are provided at wilderness access points. The materials encourage understanding of wilderness philosophy and support for its ecological and social benefits.
- A reproducing population of Apache trout is maintained in North Canyon Creek.

Objectives for Wilderness Areas

- Inspect and maintain at least 10 percent of wilderness trails and signs annually.
- Monitor 10 percent of wilderness campsites each year.

Standards for Wilderness Areas

- Establishment of geocaches is not permitted in wilderness areas.

Guidelines for Wilderness Areas

- Group size should be limited to 12 people.
- Wildfires should be suppressed in the desert communities of the Kanab Creek Wilderness.
- Wildfires in North Canyon of the Saddle Mountain Wilderness should be suppressed when high severity fire is anticipated.
- Nonnative, invasive species should be treated in order to allow natural processes to predominate.
- The fire lookout on Kendrick Mountain should be supplied and maintained using non-motorized equipment and non-mechanized transport.
- Activities in the section of Kanab Creek identified eligible as wild in the Nationwide Rivers Inventory should improve or maintain its free-flowing condition and outstanding remarkable values.

Management Approach for Wilderness Areas

Wilderness on the Kaibab NF is managed consistent with the 1964 Wilderness Act, specifically with a focus on maintaining natural processes and freedom for primitive and unconfined recreation opportunities. Further, wilderness management is guided by the elements outlined in the Forest Service's Ten-Year Wilderness Stewardship Challenge (Challenge). The ten elements outlined are: fire management, invasive plants, air quality, education planning, solitude/primitive/unconfined recreation, recreation site inventory, outfitter/guide management, management direction, data collection and analysis, and baseline workforce. While the Challenge is set to expire in 2014, its principles are useful for monitoring wilderness character and will likely continue to be incorporated in agency policy.

As every wilderness area is unique, a separate management plan should be developed for each. Wilderness plans address the specific desired conditions for each wilderness, and develop a framework for monitoring and maintenance. Monitoring is conducted to assess current conditions and to compare them to the desired condition. If current conditions depart from the desired condition, a management response may be appropriate. Responses may range from signage and education to changes in the type and intensity of allowed uses. Management responses would depend on the type and degree of departure from the desired condition.

Frank's Lake Geologic-Botanic Area

The Frank's Lake Geologic-Botanic Area is a 145-acre area on the North Kaibab Ranger District established as an ecosystem management area in the original Kaibab forest plan (1988). At 8,550 feet elevation, this geologic-botanic area represents a relatively undisturbed example of limestone sinks or karsts. There are three such sinks within the geologic-botanic area. The three sinks, along with their tributary drainage, represent various stages of geologic and vegetative development associated with the Kaibab limestone geology, which dominates the Kaibab Plateau. The easternmost sink is known as Frank's Lake and contains a grassy meadow and small pond.

In the water, typical plants include bulrush (*Scirpus* sp.), cattail (*Typha* sp.), and pondweed (*Potamogeton* sp.). Around the edges, grasses and grasslike plants include sedges, rushes, and Kentucky bluegrass (*Poa pratensis*). Blue spruce, Englemann spruce (*Picea engelmannii*), ponderosa pine, and quaking aspen characterize the surrounding forest community. The lake supports nesting mallards and various shorebirds.

Desired Condition for Frank's Lake Geologic-Botanic Area

- The natural features are preserved, perpetuating the natural geologic and ecologic processes affecting the area.
- There is minimal evidence of human disturbance.

Guidelines for Frank's Lake Geologic-Botanic Area

- Camping within the fenced boundary of Frank's Lake should not be permitted.
- Livestock should be excluded from the Frank's Lake Geologic-Botanic Area.

Arizona Bugbane Botanical Area

This 490-acre area was established as a botanical area to protect the Arizona bugbane *(Cimicifuga arizonica*). It is located in a canyon bottom on the north face of Bill Williams Mountain. Only a few population areas of this plant are known in northern and central Arizona. It is found in montane riparian habitats characterized by Douglas-fir, maple, and bracken fern (*Pteridium aquilinum*). A primary threat to this species is trampling by hikers in areas where access to the populations is easy. Uncharacteristic fire is also a threat.

Desired Conditions for the Arizona Bugbane Botanical Area

- Arizona bugbane has a sustainable population and is at low risk for extirpation.

Objectives for the Arizona Bugbane Botanical Area

- Annually inspect the recreation trails and maintain to manage hiking use.

Guidelines for the Arizona Bugbane Botanical Area

- Arizona bugbane plants should not be collected, except through scientific permit.
- Trail maintenance and any other potentially disturbing activities in the botanical area should be evaluated, and protective measures should be implemented to protect the population.
- Wildfires should be suppressed when high severity fire is anticipated.
- Public information and recreational brochures should not feature this area.

Management Approach for the Arizona Bugbane Botanical Area

Arizona bugbane is managed under USFWS direction through the Arizona Bugbane Conservation Agreement (USFWS et al. 1998). This agreement represents a commitment by the Forest Service and USFWS to manage this species to ensure that it does not become threatened or endangered. By working with the USFWS to maintain a current conservation agreement, the character of this area is maintained by limiting access and managing threats. Fire suppression activities may be needed in this area to prevent damage to the plant colony and habitat.

Double A Wild and Free Roaming Burro Territory

Wild burros have been known to occupy the area since the late 1800s. A wild burro is a free roaming, unclaimed, unbranded burro that descended from pack animals that wandered off or were released by prospectors and miners. This territory was established as required by the Wild Free Roaming Horse and Burro Act of 1971 (PL 92-195) and has been managed under cooperative agreement with the BLM since 1984. The territory is approximately 30,000 acres and is located in the northwestern portion of the Williams Ranger District, in the northern half of the Double A grazing allotment.

Desired Conditions for the Double A Wild and Free Roaming Burro Territory

- A biologically sound and genetically viable burro population is in balance with native wildlife, permitted livestock, and other resource values.

Guidelines for the Double A Wild and Free Roaming Burro Territory

- Population control measures should be implemented to maintain genetic diversity and desired resource conditions in the area.

Management Approach for the Double A Wild and Free Roaming Burro Territory

The Forest Service coordinates management of the Wild Horse and Burro program with the BLM to facilitate agency coordination to benefit both agencies. Partnering and coordination is key to maintaining the desired burro herd size through actions such as capture/relocation and fertility treatments.

Kaibab Squirrel National Natural Landmark

In 1965, 278,459 acres of ponderosa pine forest within the Kaibab NF and Grand Canyon National Park were designated as the Kaibab Squirrel National Natural Landmark. National natural landmarks (NNLs) are designated by the Secretary of the Interior and represent unique examples of ecological and geological features that comprise our Nation's natural history. The Kaibab Squirrel NNL was designated for the Kaibab squirrel and for its largely intact example of the western climax community of ponderosa pine. The Management Area boundary is that portion of the Kaibab Squirrel NNL that lies within the proclaimed boundary of the Kaibab NF. The designated boundary of the NNL is currently being evaluated and reviewed by the Department of Interior. When the review is complete, the boundary will likely be adjusted to better align with the ponderosa pine vegetation type on the Kaibab Plateau. The Plan maps and description will be updated to reflect any changes. The NNL designation is not a land withdrawal and does not direct or prohibit any activity.

Desired Conditions for the Kaibab Squirrel National Natural Landmark

- The Kaibab Squirrel National Natural Landmark provides quality ponderosa pine habitat for the Kaibab squirrel.

Management Approach for the Kaibab Squirrel National Natural Landmark

The needs for the Kaibab Squirrel NNL are addressed in the Forestwide direction for the ponderosa pine vegetation type. The Kaibab NF continues to work collaboratively with the NPS NNL Program Intermountain Regional Coordinator, as well as other interested parties, in developing a better understanding of the habitat use, distribution, and conservation needs of this unique species. Direction for areas with NNL designations requires Federal agencies to consider the unique properties of the NNL in their planning and impact analysis (Fed. Reg. 64: 25718) and provides opportunities to secure funding and develop partnerships to achieve management and conservation goals.

Grand Canyon Game Preserve

The Grand Canyon Game Preserve was established through a Presidential Proclamation by Theodore Roosevelt on June 29, 1906, to protect game species and their habitat on the Kaibab Plateau. The original proclamation does not provide a habitat management prescription, but provides a general statement about the vision. Section 1 of the Grand Canyon Game Preserve Act states, “The Reserve should be set aside for the protection of game animals and be recognized as a breeding place therefore.” The Forestwide plan direction for vegetation, wildlife, and other habitat features are consistent with the spirit of the proclamation. As a result, there is very little specific direction for this area.

Desired Conditions for the Grand Canyon Game Preserve

- The Grand Canyon Game Preserve provides quality habitat for game animals.
- There are a variety of vegetation types, in all stages of development, which provide a range of habitats for native and desired nonnative wildlife species, including natural predators.

Management Approach for the Grand Canyon Game Preserve

The Kaibab NF cooperates with the AGFD in carrying out the cooperative agreement for managing the Grand Canyon Game Preserve. The game preserve is managed in the spirit of the original proclamation, informed by advances in scientific information and societal values, with an emphasis on the wise use of natural resources.

Kaibab Plateau-North Rim Parkway

Highway 67 is designated as an Arizona State scenic road, a National Forest scenic byway, and a national scenic byway. Under the National Scenic Byway Program, the U.S. Secretary of Transportation recognizes and supports certain roads as national scenic byways or all-American roads, based on their outstanding archaeological, cultural, historic, natural, recreational, and scenic qualities. It provides resources to help manage the intrinsic qualities within the broader byway corridor to be treasured and shared.

The Kaibab Plateau-North Rim Parkway was designated because of its scenic beauty and natural and cultural history. The byway nomination mentions that Highway 67 is unique in that the entire route is located on NFS and national park lands and therefore contains an opportunity to highlight natural resource management activities. The Kaibab Plateau-North Rim Parkway is managed to provide visitors with opportunities to enjoy the outstanding scenery and the natural and cultural landscapes of the Kaibab Plateau. The route follows Arizona State Route 67 from Jacob Lake, to the north rim of Grand Canyon National Park. Open seasonally, the parkway travels through ponderosa pine, mixed conifer forests, and high country meadows on its way to the Grand Canyon. Wildlife such as deer, wild turkeys, coyotes (*Canis latrans*), and many bird species is abundant in the area.

Desired Conditions for the Kaibab Plateau-North Rim Parkway

- The Kaibab Plateau-North Rim Parkway provides exceptional opportunities for scenic driving.
- Views along the byway are natural appearing and include a variety of landscape characteristics including coniferous forest, aspen, and other deciduous species, and high-elevation meadows.
- Road corridor improvements and interpretive facilities are designed and constructed to blend with and complement the natural and cultural environment surrounding the byway and to facilitate animal movement.
- Facilities are designed to accommodate people with varying abilities.
- Forest management activities remain largely unnoticeable.
- The byway exhibits natural appearing landscapes where human activities do not stand out in the foreground, for up to one-half mile (high scenic integrity).

National Scenic and Recreation Trails

Congress established a system of national scenic, historic, and recreation trails under the authority of the National Trails System Act of 1968. Five such designated trails or trail systems occur on the Kaibab NF. On the Kaibab NF there is one national scenic trail and two national recreation trails.

National scenic trails are established as extended trails located to provide for maximum outdoor recreation potential and for the conservation and enjoyment of the nationally significant scenic, historic, natural, or cultural qualities of the areas through which they pass. These trails can only be designated by Congress. National recreation trails are established to provide a variety of outdoor recreation uses in or reasonably accessible to urban areas. Within NFS lands, these trails are designated by the Secretary of Agriculture.

Arizona National Scenic Trail

The Arizona National Scenic Trail is a nonmotorized, primitive trail that stretches over 800 miles from Mexico to Utah across Arizona. It connects deserts, mountains, forests, wilderness, canyons, historic sites, communities, and people, and passes through some of the most renowned landscapes in the State. The Arizona National Scenic Trail is Arizona's only national scenic trail, and one of only five national scenic trails administered by the Forest Service. It showcases the State's diverse life zones and scenery. A wide variety of nonmotorized recreationists use the trail including hikers, equestrians, mountain bicyclists, and cross-country skiers. The trail covers about 90 miles on the Kaibab NF—40 miles on the Tusayan District and 50 miles on the North Kaibab Ranger District. The trail crosses Grand Canyon National Park, connecting the two segments on the Kaibab NF.

I-40 – Parks Rest Area National Recreation Trail

The I-40–Parks Rest Area National Recreation Trail was designated in 1979. It is a self-guided interpretive trail located immediately adjacent to the westbound rest area on Interstate 40,

between Flagstaff and Williams, Arizona. The half-mile paved trail provides information about the ponderosa pine forest, Forest Service management, and nearby recreation opportunities.

Bill Williams Mountain Complex National Recreation Trails

The Bill Williams Mountain Complex National Recreation Trails are a series of nonmotorized trails accessing Bill Williams Mountain. It includes the Clover Springs Bypass, Buckskinner, City Link, Benham, Bill Williams, and Bixler Saddle Trails. The trails start in the ponderosa pine vegetation type and climb the flanks of the mountain providing panoramic views of the Williams Ranger District. The trails offer a variety of hiking opportunities from moderate to difficult.

Desired Conditions for National Scenic and Recreation Trails

- Views in the immediate foreground (0 to 300 feet) of national scenic and recreation trails include natural-appearing landscapes. The landscapes have high scenic values and generally appear unaltered by human activities.
- Signage helps users find nearby developed sites, trailheads, recreation facilities, and drinking water sources.
- User conflicts between differing recreational uses are infrequent.
- In remote areas, the sights and sounds of roads, motorized trails, utility corridors, and other facilities are rarely encountered.
- The Arizona National Scenic Trail provides both short and long-distance nonmotorized recreation opportunities in mainly remote and primitive settings representative of the dramatic natural landscapes and varied vegetation of Arizona.
- Along most of the Arizona National Scenic Trail, infrastructure and facilities are few and are constructed in such a way as to be compatible with the scenic, natural, historic, and cultural qualities for which the trail was established. Connecting or side trails may provide access to developed areas and amenities.

Guidelines for National Scenic and Recreation Trails

- Projects should preserve the recreation opportunity setting for any affected segments, particularly within ½ mile of the Arizona National Scenic Trail.
- Special use authorizations for trail segments that receive high public use should be limited, and compatible with the original intent for the trail's national designation.

Management Approach for National Scenic and Recreation Trails

The Kaibab NF works with the Arizona Trail Association, volunteer groups, and adjacent landowners to maintain trail corridors and the condition and character of the surrounding landscape. None of these trails are in wilderness, so motorized vehicles may be used for trail maintenance and administrative use.

A comprehensive plan is currently being developed for the Arizona National Scenic Trail that will: provide management direction for its use including, but not limited to, specific objectives and practices to be observed in management of the trail; the identification of all significant natural, historical, and cultural resources to be preserved; detail any needed cooperative

agreements; identify carrying capacity of the trail and a plan for its implementation. Until the comprehensive management plan is completed, the Kaibab NF would use strategies specified in the 1995 "Arizona Trail Management Guide" and national scenic trail management guides.

See also "Recreation and Scenery."

Management Areas

Management areas have been established for places on the Kaibab NF with a need for more specific management direction than the general Forest. They may be discrete or overlapping. Where there are apparent differences in plan direction, the finer, more restrictive guidance applies.

Recommended Wilderness Areas

The Recommended Wilderness Area MA is comprised of lands recommended for wilderness designation as a result of a potential wilderness area (PWA) evaluation process. The purpose of this evaluation was to identify all areas within the Kaibab NF not yet designated as wilderness that satisfy the definition of wilderness found in the 1964 Wilderness Act. The Kaibab NF followed a 3-step process for identifying PWAs that included inventory and evaluation of potential areas and a determination of which areas would be included in this plan. The intent of this management area is to provide direction that would retain or improve the wilderness values of these areas if and until they are established by Congress.

The Kaibab NF is recommending four PWAs for wilderness designation. One PWA is on the Williams Ranger District, adjacent to Sycamore Canyon Wilderness, at the head of Jacks Canyon (about 160 acres). Three are located on the North Kaibab Ranger District: one PWA is comprised of eight separate areas bordering the Kanab Creek Wilderness (totaling about 4,700 acres), one adjacent to the Saddle Mountain Wilderness that includes a unique landform commonly referred to as the "Cockscomb" (approximately 1,300 acres); and one adjacent to Grand Canyon National Park that includes the upper reaches of Grassy and Quaking Aspen Canyons (about 230 acres). The PWAs adjacent to the Grand Canyon National Park, Kanab Creek Wilderness, and Sycamore Canyon Wilderness would bring the boundary of the area managed as wilderness to the rim, which would be more recognizable and manageable.

Desired Conditions for Recommended Wilderness Areas

- Recommended wilderness provides non-motorized and non-mechanized opportunities for primitive and unconfined recreation and contiguous wildlife habitat. Social encounters are infrequent and occur only with individuals or small parties.
- The environment is essentially unmodified. No services are provided and self-reliance is required. The naturally occurring scenery dominates the landscape. Manmade features are rare and use natural or complimentary materials. Some constructed features are present when needed to provide for public safety or resource protection.
- Enduring, high-quality wilderness values are maintained while providing for solitude and primitive, unconfined recreation experiences.
- Natural processes are maintained within wilderness. Fires function in their natural ecological role.
- Wilderness areas have minimal to no nonnative, invasive species.

- Maps, information, and educational material are provided at wilderness access points. The materials encourage understanding of wilderness philosophy and support for its ecological and social benefits.

Guidelines for Recommended Wilderness Areas

- Activities should maintain or improve the wilderness character until such time as Congress acts on the recommended area, either making it designated wilderness or releasing it for other management.
- Wildfires should be suppressed in the recommended wilderness areas adjacent to Kanab Creek in the desert communities vegetation type.
- Nonnative, invasive species should be treated within recommended wilderness areas in order to allow natural processes to predominate.
- Competitive events should not be permitted in recommended wilderness areas.

Management Approach for Recommended Wilderness Areas

Recommended wilderness on the Kaibab NF is intended to be managed consistent with the intent of the 1964 Wilderness Act, specifically with a focus on maintaining or achieving wilderness values. Although all of these areas have been managed as semi-primitive non-motorized areas in the past, they have not been managed as wilderness. Some contain evidence of human activities such as old roadbeds, stumps from timber sales, and livestock management structures.

Management may be needed including restoration, trail maintenance, and road obliteration to achieve or retain the desired wilderness values. Because recommended wilderness is not designated wilderness, use of motorized or mechanized equipment may be appropriate when it is used to move the areas toward the desired natural appearing primitive settings.

Wildland-urban Interface Areas

The wildland-urban interface (WUI), in general terms, is the wildland area surrounding resident populations and other human developments having special significance that are at imminent risk from wildfire. People increasingly seek to live in more secluded lands bordering public lands. At the same time, large, high-severity wildfires are increasing in occurrence as the conditions of forests become more departed from reference conditions, putting these widely spaced homes and rural communities at risk. This creates the most dangerous and complex fireline situations that Federal, municipal, and rural firefighters face. Desired conditions and guidelines specific to this area are necessary to reduce the risk to firefighter safety, as well as to human developments.

The Healthy Forest Restoration Act (HFRA) of 2003 defines the WUI as an area within or adjacent to an at-risk community that is identified in a community wildfire protection plan (CWPP). Two CWPPs have been prepared that have large WUI zones that overlap Kaibab NF. The WUI zone outlined in the Greater Williams Area CWPP covers all of the forested cover type on the Williams Ranger District and is 326,000 acres in size. The Tusayan CWPP WUI zone covers 63,720 acres—nearly 20 percent of the district. The rationale for such large zones is that wildfires in recent history, under critical fire danger conditions, have demonstrated rapid rates of

spread over great distances in a single burning period, posing threats to communities and infrastructure miles from the point of origin.

Achieving desired conditions for the entirety of the CWPP WUI zones is a long-term aspiration, but it is not within the capacity of the Forest Service to achieve within the projected life of this plan. Also, these zones do not cover many other highly valued human developments at risk on, and adjacent to, the Kaibab NF. For the purposes of this plan, the WUI area is refined to a buffer around WUI values to focus more intensive treatments where they will have the most impact for fire protection, and includes the following lands:

- Half-mile buffer around all private lands.
- Half-mile buffer around administrative sites, fee use cabins, fire lookouts, developed campgrounds, day use picnic areas, and facilities managed under special use permits.
- Half-mile buffer around at-risk communication sites.

Desired Conditions for WUI Areas

- Wildland fires in the WUI do not result in the loss of life, property, or characteristic ecosystem function.
- Wildland fires in the WUI are low intensity surface fires. Firefighters are able to safely and efficiently suppress wildfires in the WUI using direct attack.
- The desired tree basal area in the WUI is on the lower end of the range given in the vegetation community desired conditions.
- Openings with grass/forb/shrub vegetation occupy the mid to upper end of the percentage range in the desired conditions. Trees within groups may be more widely spaced with less interlocking of the crowns than desirable in adjacent forest lands.
- Logs and snags, which often pose fire control problems, are present in the WUI, but at the lower end of the range given in the vegetation community desired conditions.
- Higher fuel loading or tree densities may be desired in areas where it provides for important fine scale habitat structure, as long as it meets the overall intent of protecting WUI values at risk.
- Ladder fuels are nearly absent.
- Dead and down fuel load is between 1 and 5 tons per acre. This light fuel load is desirable even in vegetation types with higher reference fuel loads, such as mesic mixed conifer, to provide improved fire protection to human developments deemed to have special significance.
- When WUI intersects vegetation types with a mixed or high-severity fire regime, characteristic ecosystem function is modified to promote low intensity surface fires.
- Openings between tree groups are of sufficient size to discourage isolated group torching from spreading as a crown fire to other groups.

Management Approach for WUI Areas

Firefighters need more open stands, with few ladder fuels and low fuel loadings, where wildfires drop to the surface before they reach the values at risk. Treatments in the WUI area are designed to provide a zone where firefighters can safely perform direct attack on wildfires. The more open

stand conditions also serve to protect NFS lands from human-caused fires started on private lands because firefighters can more readily contain a wildfire before it burns into denser, more flammable vegetation in the Kaibab NF at large.

While fire protection is the key objective in this area, other resource objectives are also met, and the integrity of the ecosystem is maintained. Treatments are guided by the same Forestwide desired conditions for resources, goods, and services as outside the zone, but lands within the WUI area are managed to achieve the more open end of the desired conditions for the vegetation community.

A half-mile buffer around human developments is the starting point for determining where more open, intensive treatments occur. This distance is recommended in the HFRA (2003) and provides a distance conducive for passive crown fire to transition to surface fire. During project-specific planning, the area where more intensive treatments are needed may call for adjustment. Continuous steep slopes, continuous heavy fuels, or other fire hazards may indicate a need to expand more open treatments. On the other hand, sound reasons for retaining more dense stands may exist. For example, in the case of a habitat for a narrow endemic species, less intensive treatment, no treatment, or moving the buffer area to the outside or around the more densely stocked area may be necessary.

All private lands, regardless of whether they contain human improvements or the type of improvements they contain, are treated as WUI. In doing so, making subjective value judgments on different structures is avoided. It also accounts for the potential that any given private inholding could be developed during the lifespan of the plan.

Due to variable budgets, market capacity, and workforce capacity, achieving desirable structural changes through planned mechanical treatments is sometimes delayed or occurs sporadically. Projects that include lands in the WUI should allow flexibility in the order of treatment implementation. This allows fire managers the option to burn before mechanical treatments, greatly reducing fire hazard in the WUI area in the interim until mechanical treatments take place.

Including maintenance burning in project design is essential to securing the investment made with mechanical thinning and initial entry burns. Without maintenance burning, the fire protection value from treatments is largely lost within 40 to 50 years because of increased fuel loads and more densely stocked stands.

Well planned trails at the WUI provide sufficient legal access between NFS trails and neighborhoods, reducing the potential development of user-created social trails.

See also major vegetation communities and "Wildland Fire Management."

West-wide Energy Corridor

Two corridors were identified in the "West-wide Energy Corridor Record of Decision" (ROD) that cross the Kaibab NF, both of which follow existing high-voltage lines (500 kV). One is on the Tusayan Ranger District, which follows the Four Corners line (No. 47-68), and crosses the southern portion of the district. The other corridor is located on the Williams Ranger District (No. 61-207), which follows the Navajo Project Line across the district from the southwest to the northeast. These corridors were defined in the ROD as being 3,500-feet wide with the centerline identified as the center of existing transmission line and as open to both pipeline and transmission

line development. Both of these corridors were identified in the original 1988 Kaibab Forest plan to allow expansion for major utility lines. The "Environmental Impact Statement for the West-wide Corridor" identified potential energy corridors; evaluated effects resulting from their designation; identified mitigation measures of potential effects anticipated from future development; and included interagency operating procedures applicable to the planning, construction, operation, and decommissioning of future projects within the corridors. The environmental consequences of any future projects would be evaluated in site-specific project-level planning. The West-wide Corridor decision to designate energy corridors on NFS lands in 10 western states is programmatic in nature and does not authorize specific right-of-way projects. Future development within the corridors would need to meet appropriate NEPA requirements and comply with other applicable laws, regulations, and policies.

Desired Conditions for the West-wide Energy Corridor

- The West-wide Corridor provides for energy transmission needs across the Kaibab NF.

See also "Energy Transmission and Development" section of this plan.

Developed Recreation Sites

This MA totals 1,556 acres and includes 15 major public and private sector developed recreation sites and other smaller sites (trailheads, interpretive sites, etc.). Many visitors to the Kaibab NF campgrounds and lodges come from the Phoenix metropolitan area for relief from extreme summer temperatures.

Most campgrounds in the Williams Ranger District unit are adjacent to impounded lakes that offer water-oriented recreation activities. Most of the fishing use on the Kaibab NF occurs in this MA. All fish are stocked by the AGFD. With the exception of White Horse Lake, all of these lakes are water storage facilities for the city of Williams. Campground capacity is established to ensure water quality preservation.

Desired Conditions for Developed Recreation Sites

- Developed campgrounds are places where structures and human impacts on vegetation may be seen, but they do not dominate the view or attract attention (low to moderate scenic integrity).
- Human activities in the areas visible from campgrounds (foreground to middle ground, 300 feet to 4 miles) do not attract attention or stand out, and the landscapes appear natural (moderate to high scenic integrity).
- Volunteer hosts are provided at all public sector fee campgrounds.

Objectives for Developed Recreation Sites

- Reconstruct or construct at least one-quarter of developed campsites into small group sites within 10 years of plan approval.

- Reduce developed site recreation deferred maintenance by an average of 5 percent each year.

Guidelines for Developed Recreation Sites

- Reconstruction and improvements of private sector developed sites should be within site capacity allocations.
- Surveys should be conducted to assess bat activity and intensity of use before demolishing and/or modifying structures such as old buildings. If surveys determine that bats are actively roosting in such structures and no alternate bat roost sites exist in the immediate vicinity, project design should include efforts to minimize impacts and to provide for alternate roost sites such as bat boxes where feasible.
- Developed recreation site vegetation management plans should guide tree removal and burning activities in the campgrounds.

See also the "Recreation and Scenery" section of this plan.

Garland Prairie Management Area

The Garland Prairie Management Area is an approximately 340-acre area on the Williams Ranger District that was identified as a potential research natural area (RNA) in the original forest plan but was never designated. Garland Prairie is typical of the high elevation grassland ecotone dominated by Arizona fescue (*Festuca arizonica*) and mountain muhly (*Muhlenbergia montana*). RNAs are field ecological research areas established for the purpose of research, observation, and study. They are selected and established to preserve a wide spectrum of pristine areas that typify important habitat types and serve to preserve and maintain genetic diversity, maintain baseline or reference areas for the study of ecologic changes, and as a control to other similar habitats being manipulated for research or management purposes. When Garland Prairie was originally recommended as RNA, there was a need for montane grassland type representation. This is no longer true, and as a result, it does not meet the criteria identified in the Region 3 RNA process. This area was considered to be in "good" condition when livestock was excluded in 1989However, since then there has been tree encroachment by ponderosa pine and infestations of Dalmatian toadflax. This area was retained as a management area because of its value as a reference area for research and management purposes.

Desired Conditions for the Garland Prairie Management Area

- The area serves as a reference for the study of ecologic changes and as a control to other similar habitats being manipulated for research or management purposes.
- Lightning fires are able to burn naturally within the area.

Objectives for the Garland Prairie Management Area

- Inspect the boundary fence annually and maintain as needed.

Guidelines for the Garland Prairie Management Area

- The area should be protected from activities that directly or indirectly modify ecologic processes.

Management Approach for the Garland Prairie Management Area

The PNVT for the Garland Prairie Management Area is “montane/subalpine grassland.” While Garland Prairie would not necessarily make a good RNA, the Kaibab NF recognizes it has continued value as a reference area and as high quality grassland habitat as it is known to support some of the highest fawn: doe ratios for pronghorn anywhere in the state of Arizona.

Bill Williams Mountain Management Area

Bill Williams Mountain has been identified as a management area because it contains multiple resources and uses of high natural, cultural, and economic value. It is eligible as a traditional cultural property, and has been identified as a sacred site by American Indian tribes. It contains a Mexican spotted owl protected activity center, the Arizona Bugbane Botanical Area, and communication towers that serve the Arizona Department of Public Safety, U.S. Customs and Border Protection, and Federal Aviation Administration. The mountain contains a ski area, a fire lookout tower, and national recreation trails. The watershed makes up a large portion of the municipal water supply for the city of Williams and contains the headwaters of Cataract Creek, which flows into the Havasu drainage and ultimately onto the Havasupai Reservation and Village.

This management area has the highest value per acre on the Kaibab NF with regard to both economic and amenity considerations. It is at high risk for uncharacteristic wildfire due to its steep slopes, dense vegetation, and high fuel loading. If a large wildfire occurred within the area, it could adversely affect many valuable resources.

Desired Conditions for the Bill Williams Mountain Management Area

- The risk is low for substantial damage to municipal water supply, infrastructure, water quality, visual quality, and cultural integrity (e.g., tribes and local communities).
- The risk of damage to electronic sites is low and communication related to the site is uninterrupted.
- Bill Williams Mountain provides quality habitat for Arizona bugbane, Mexican spotted owls, and culturally important plants.

Objectives for the Bill Williams Mountain Management Area

- Implement a project to improve the health and sustainability of forested conditions on and surrounding Bill Williams Mountain within 5 years of plan approval.

Standards for Activities in Bill Williams Mountain Management Area

- Artificial snow making within the Bill Williams MA will not be permitted.

Guidelines for Activities in Bill Williams Mountain Management Area

- The existing term permit for the Elk Ridge Ski Area on Bill Williams Mountain should be restricted to the existing established permit area.
- High-use roads within the municipal watershed should be maintained to prevent erosion and sedimentation.
- Commercial plant collection within the Bill Williams MA should not be permitted.
- Vegetation treatments immediately adjacent to the Arizona Bugbane Botanical Area should leave enough tree cover to maintain cooler temperatures and higher humidity microsite conditions near the bugbane populations.

Management Approach for the Bill Williams Mountain Management Area

Project planning would best be served by a collaborative process because of the complexity of the multiple high values and stakeholders. Seasonality of uses, access, and resource needs call for coordination and consideration of timing of implementation in project planning.

The highest priority for fuel reduction treatment is the north and east slopes because of the potential risk and consequences of a high-intensity wildfire. Steep slopes and concerns about erosion and sedimentation may call for treatments to either treat fuels in place or use cable or aerial harvest systems. Other priority areas for treatments are in the WUI.

See also "Traditional and Cultural Uses," "Special Uses," major vegetation communities, "Wildlife," and "Wildland Fire Management."

Red Butte Management Area

The Red Butte Management Area is of particular importance to several American Indian tribes. It lies within a larger area that is eligible for inclusion on the National Register of Historic Places as a traditional cultural property and has been identified as a sacred site to American Indian tribes in the area. TCP boundaries are largely confidential and do not usually correlate to features that can be identified on the ground. The Red Butte MA boundary was selected to include the geologic formation of Red Butte, the core area of the eligible TCP, and to facilitate manageability.

Desired Conditions for the Red Butte Management Area

- The environment is essentially unmodified. Naturally occurring scenery dominates the landscape.

Guidelines for the Red Butte Management Area

- Activities should be coordinated with tribes to minimize impacts to ceremonial activities.

- Temporary closures should be implemented upon request by the tribes to provide privacy for traditional activities.
- The helipad on Red Butte should only be used for administrative purposes.
- Commercial use such as outfitter guides, plant collection, and firewood cutting/collection in the Red Butte MA should not be permitted.

Management Approach for Red Butte Management Area

Tribal members have identified air traffic surrounding Red Butte as disruptive to tribal ceremonies. The Forest Service does not have the authority to regulate air traffic (flights), so it is important that the Kaibab NF work closely with and educate potential operators about the impacts. When temporary closures are in place for traditional or ceremonial use, a request for air operators to avoid the area may be made.

House Rock Wildlife Area

The bison herd has been present on the North Kaibab Ranger District for more than 100 years, and was specifically mentioned in legislation leading to the Grand Canyon Game Preserve. The State of Arizona owns and manages this free-ranging bison herd on the Kaibab NF through an agreement between the AGFD and the U.S. Forest Service.

Desired Conditions for the House Rock Wildlife Area

- Bison are a desired introduced wildlife species within the designated House Rock Wildlife Area in House Rock Valley.
- There are opportunities to hunt bison.
- The bison herd size is in balance with ecological conditions in the House Rock Wildlife Area.

Guidelines for the House Rock Wildlife Area

- The bison should be managed so that the herd is concentrated within the House Rock Wildlife Area.
- Active management should be used to minimize impacts from bison to sensitive resources, particularly outside the House Rock Wildlife Area.

Management Approach for the House Rock Wildlife Area

Coordination and cooperation between the Kaibab NF, AGFD, Grand Canyon National Park, and researchers will be needed to identify workable solutions for managing the bison, which are now spending much of their time in the remote forested areas of the Kaibab Plateau. Efforts to achieve the desired conditions will likely be implemented in phases with an initial emphasis on reducing the herd size and excluding them from Grand Canyon National Park. Strategies may include hunting and trapping, fencing, and herding.

Pediocactus Conservation Area

Pediocactus paradinei B.W. Benson (which is also known as the Paradine or Kaibab plains cactus) was previously a Category 1 candidate for listing as endangered by the Fish and Wildlife Service. In lieu of formal listing, an interagency conservation assessment and strategy was prepared for the Paradine plains cactus. This management area was established to aid in managing this species.

Desired Conditions for the Pediocactus Conservation Area

- Paradine plains cactus *(Pediocactus paradinei)* has a sustainable population and is at low risk for extirpation.

Guidelines for the Pediocactus Conservation Area

- Collection of Paradine plains cactus plants should not be permitted.
- Project activities should incorporate protective measures for the Paradine plains cactus. Any potentially ground-disturbing activities in the Pediocactus Conservation Area should be evaluated, and protective measures should be implemented to minimize resource impacts.
- Nonnative invasive weeds should be regularly monitored and promptly treated.
- Wildfires in the Pediocactus Conservation Area should be managed under a suppression strategy when high severity fire is anticipated.
- Motorized access should be restricted.
- Public information and recreational brochures should not feature this area.

Management Approach for the Pediocactus Conservation Area

Pediocactus paradinei is managed under a conservation assessment and strategy developed by the Forest Service, BLM, and USFWS (USDA et al. 1997). This document represents the desire to achieve self-sustaining populations of *Pediocactus paradinei*. By working with the USFWS and BLM to maintain a current conservation assessment and strategy, the character of this area is maintained by limiting access and managing threats. Suppression actions may be needed to prevent damage to the plants and habitat.

See also sections for "Pinyon-juniper Communities," "Sagebrush Shrublands," "Rare and Narrow Endemic Species," and "Nonnative Invasive Species."

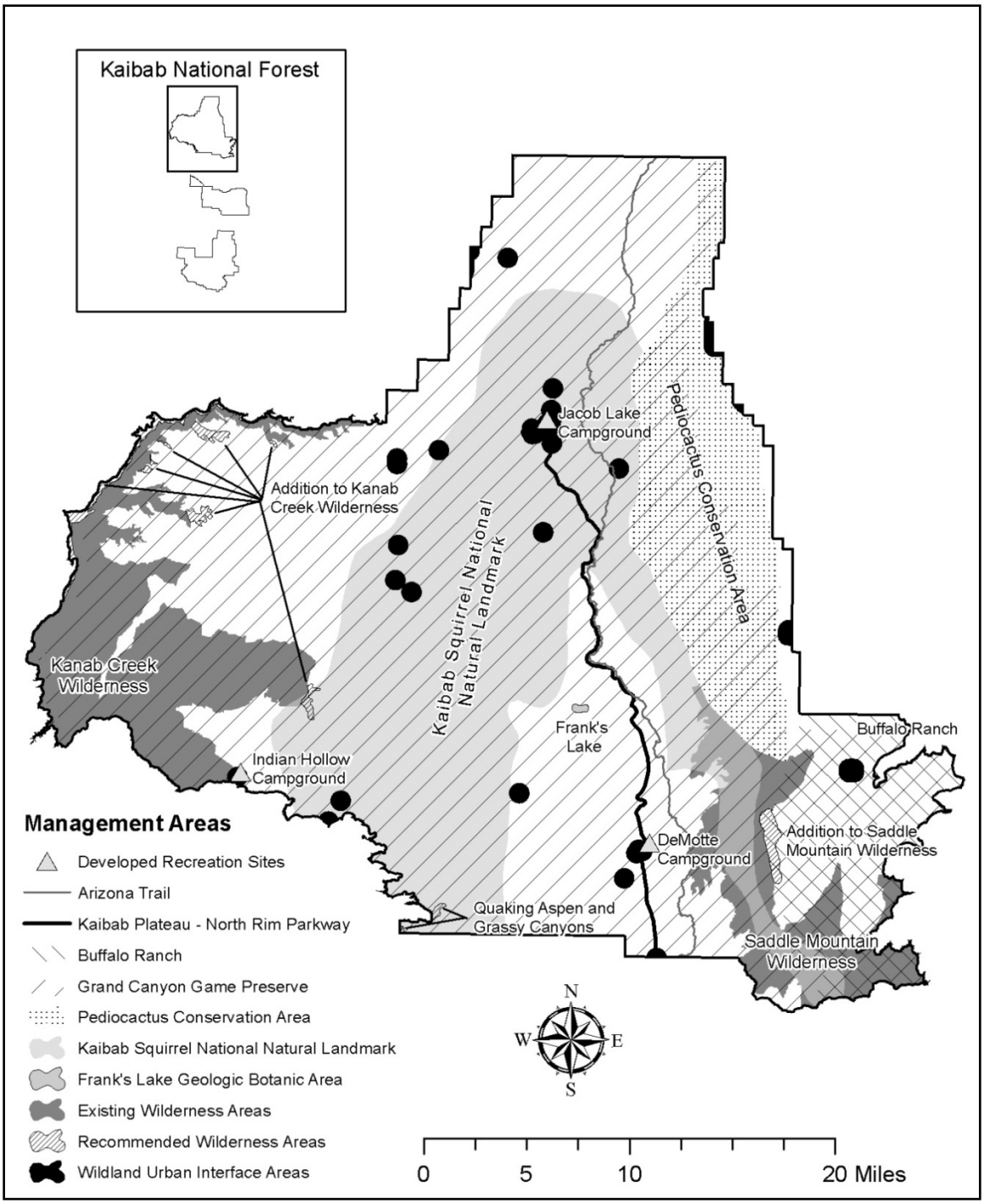

Figure 2. Management areas on the North Kaibab Ranger District

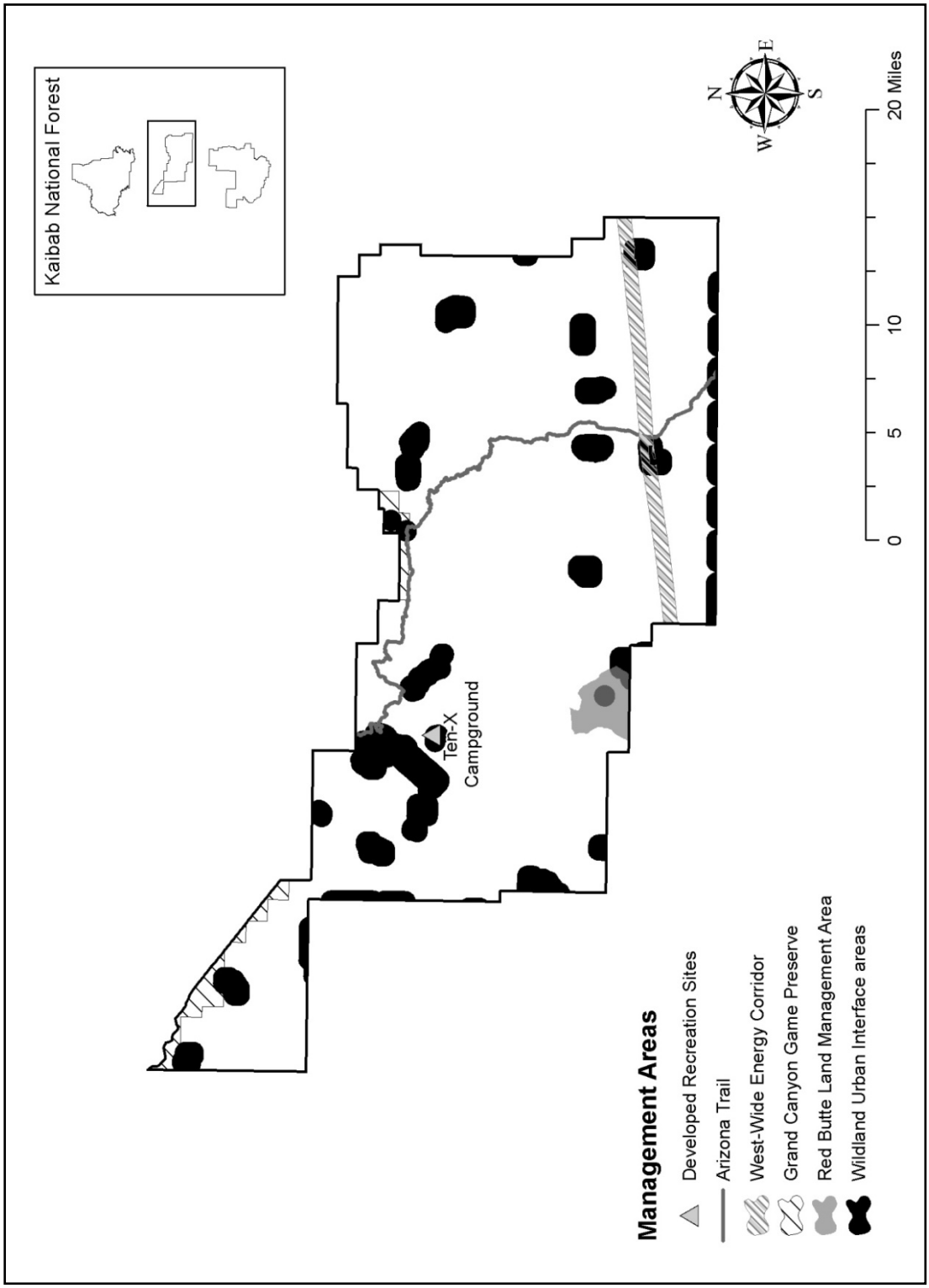

Figure 3. Management areas on the Tusayan Ranger District

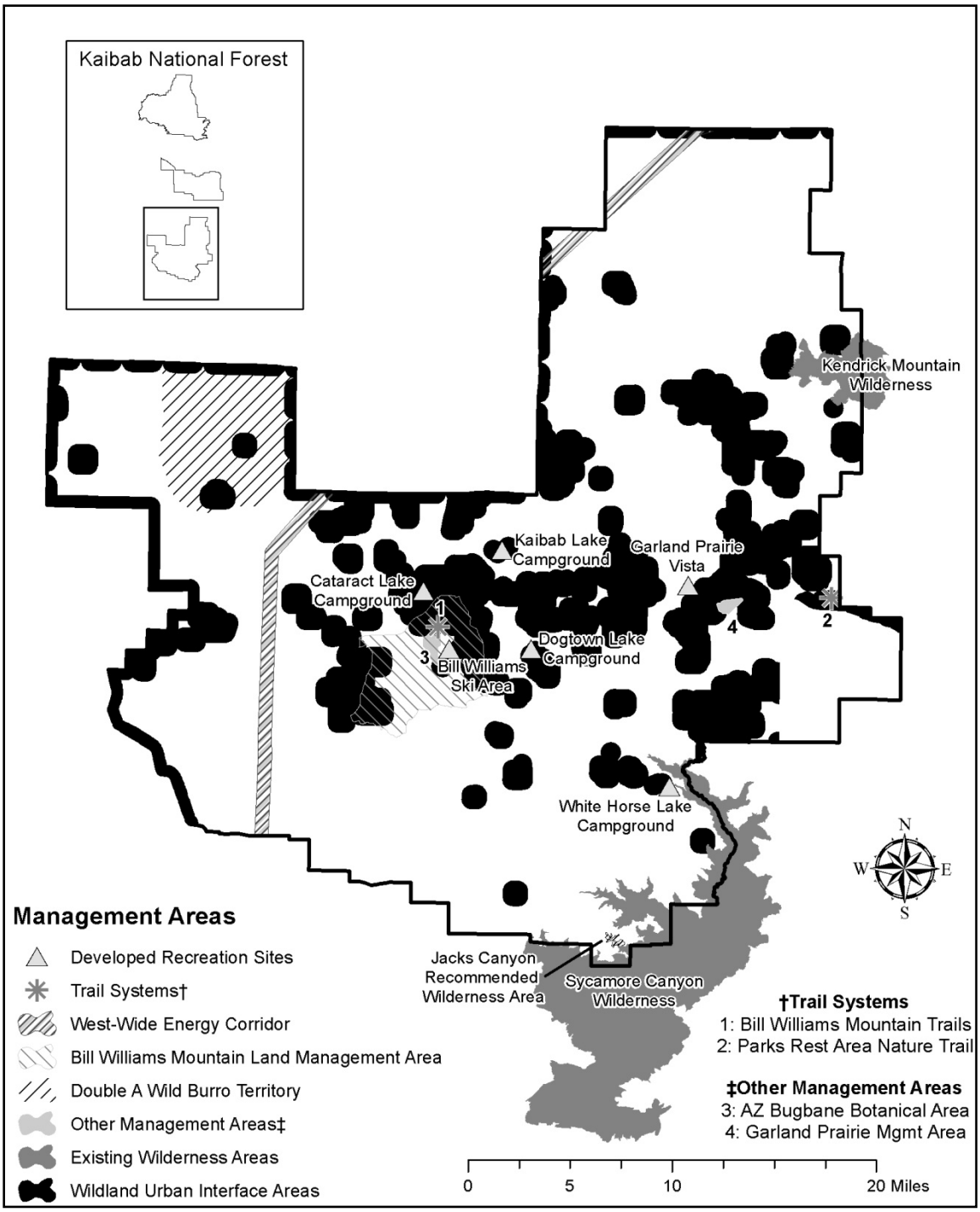

Figure 4. Management areas on the Williams Ranger District

Chapter 4. Suitability

The National Forest Management Act (NFMA) states that national forest plans shall provide for multiple use and sustained yield of products and services through management of renewable surface resources to best meet the needs of the American people. NFMA also requires that NFS lands be classified as to their suitability for various uses, including timber production, forage production, and recreation opportunities. Suitability is the appropriateness of applying certain resource management practices to a particular area of land in consideration of the relevant social, economic, and ecological factors. Suitability is determined based on compatibility with desired conditions and objectives in the plan area. Lands identified in the plan as suitable or not suitable for a particular use does not mean that the use will or will not occur on those lands. Suitability decisions provide guidance for project and activity decision making, and are not commitments or final decisions approving projects and activities.

Timber Suitability

The NFMA requires that NFS lands be classified as to their suitability for timber production. NFS lands were reserved with the intent of providing goods and services to satisfy public needs over the long term. These goods include the production of a sustainable supply of forest products. Timber production is the purposeful growing, tending, harvesting, and regeneration of regulated crops of trees for industrial or consumer use. Timber production activities can contribute to social, economic, or ecological sustainability. Timber production has the potential to offset some or all of the costs of thinning and other forest development or maintenance activities that lower uncharacteristic fire and insect risk, increase understory plant diversity and abundance, and create employment opportunities.

Areas unsuitable for timber production are those that are either not desirable or not feasible to manage for periodic harvests of forest products. For example, restoration of grasslands often requires cutting trees. These trees can be made available for sale, but the intent for the future is to maintain the areas as grasslands, and as a result timber production would not be desirable because it is inconsistent with the desired conditions. Where long-term resource productivity would be impaired or law, regulation, or policies prohibit it, timber production is not feasible.

In accordance with the provisions of the current planning rule, a GIS analysis was conducted on all NFS lands managed by the Kaibab NF to derive acres of land categorized into suitable and not suitable for timber production, which varied by alternative (219.14). Lands not suitable for timber production were removed and placed into the following categories: nonforested (219.14(a)(1)), irreversible resource damage (219.14(a)(2)), adequate restocking not assured (219.14(a)(3)), and withdrawn (219.14(a)(4)). The remaining land was then categorized as tentatively suitable for timber production.

Lands not appropriate for timber production were removed from the tentatively suitable lands category into lands where management area prescriptions preclude timber production (219.14(c)(1)), lands where management requirements (219.27) cannot be met (219.14(c)(2)), and lands not cost efficient in meeting timber objectives (219.14(c)(3)). Table 1 provides acreages used in the timber suitability calculation. More information about this process can be found in the "Final Environmental Impact Statement for the Kaibab NF Land and Resource Management Plan, Appendix C."

Table 1. Timber suitability calculation for the Kaibab NF

Land Category	Acres
Gross area of Kaibab NF	1,600,321*
Area not administered by the Forest Service (Camp Navajo and private lands)	-57,056
NFS lands administered by the Kaibab NF	1,543,265
Non-forested†	-847,376
Irreversible resource damage	-54,265
Adequate restocking not assured	-21,834
Withdrawn (219.14(a)(4))	-117,563
Subtotal: Not-suitable for timber production	*1,041,038*
Lands Tentatively Suitable for Timber production	**502,227**
Management prescriptions preclude timber production	-90,782
Management requirements cannot be met	-16,903
Not cost efficient in meeting timber objectives	-13,025
Subtotal: Not appropriate for timber production	*-120,710*
Lands suitable for timber production	**381,517**

* Acreages of NFS lands may vary slightly over time due to factors such as resurvey, improved mapping technology, and updates to corporate GIS layers.
† Includes Forest lands that are not capable of producing industrial wood, such as pinyon-juniper woodlands.

Grazing Suitability and Capability

The 1982 Planning Rule requires that the suitability of rangelands on NFS lands and their capability for producing forage for grazing animals be determined in forest planning. Capability is the potential of an area of land to produce resources and supply goods and services. Capability depends upon conditions such as climate, slope, landform, soils, and geology. Suitability is the appropriateness of applying certain resource management practices to a particular area of land in consideration of the relevant social, economic, and ecological factors. Lands within the plan area are not suitable if livestock grazing would be incompatible with the desired conditions or result in substantial and permanent impairment of the land.

Capability to produce forage for grazing animals was determined for the original forest plan (USDA 1988). Most landscape-scale conditions that influence capability have not changed significantly since the initial evaluation. However, the data and analysis tools used in the initial determination were not as accurate or precise as what is available today. Capability for this plan was reassessed using the corporate GIS data. Table 2 displays the results of this analysis. The area capable for livestock grazing has about 12 percent fewer acres than the original forest plan. More detail about the process and rationale behind these calculations are documented in the white paper “Grazing Capability Calculations for the Kaibab NF,” which is filed in the project record.

Table 2. Grazing capability calculations for the Kaibab NF

Grazing Capability Category	Acres
Gross area of Kaibab NF	1,600,321*
Area not administered by the Forest Service (Camp Navajo and private lands)	-57,056
Net Analysis Area	1,543,265
Slopes greater than 40 percent	-165,672
Severe erosion hazard (Terrestrial Ecosystem Survey)	-176,554
Forage productivity less than 100 lb/ac/yr (based on TES)	-87,921
Total "No Capability" Areas	-430,147
Lands tentatively capable for livestock grazing	1,113,118

* Acreages of NFS lands may vary slightly over time due to factors such as resurvey, improved mapping technology, and updates to corporate GIS layers.

The original plan identified four management areas as unsuitable for livestock grazing: the Arizona Bugbane Botanical Area, Garland Prairie Management Area, Franks Lake Geologic/Botanic Area, and developed recreation sites. These management areas are still identified as unsuitable, but a 219-acre adjustment was made to the area managed as developed recreation sites. Two developed recreation sites have been closed since the original plan was signed and they are no longer managed for recreation: Moqui Lodge and Benham Snowplay Area, 202 and 17 acres, respectively. The desired conditions for these areas would no longer preclude livestock grazing. As a result, this revised plan shows these areas as suitable for livestock grazing.

Since the original plan was approved, each allotment on the Kaibab NF has received site-specific environmental review for the authorization of grazing consistent with the National Environmental Policy Act (NEPA). The grazing decisions for those site-specific analyses were reviewed for areas where livestock grazing was not authorized. Site specific NEPA identified three large contiguous areas were not authorized for grazing following environmental review: the Kanab Creek allotment, Jump-up pasture of the Central Winter allotment, and the Bill Williams Mountain portion of the Hat allotment. In this revised plan, these areas have been identified as not suitable for livestock grazing. Table 3 and Figure 5 . show the areas on the Kaibab NF where livestock grazing is not authorized due to incompatibility with desired conditions. Of the approximately 1.13 million acres identified as tentatively capable for livestock grazing, about 14 thousand acres are not suitable The total area that is both capable and suitable is about 1.1 million acres.

Table 3. Areas unsuitable for grazing on the Kaibab NF

Feature	Acres	Note
Arizona Bugbane Botanical Area	490	Management areas closed to grazing in the original Kaibab Forest Plan (1988).
Garland Prairie	328	
Franks Lake Geologic-Botanic Area	145	
Existing Developed Recreation Sites	1,397	
Kanab Creek Allotment	39,280	Closed to grazing: site-specific NEPA decision, March 2001.
Jump-up Pasture, Central Winter Allotment	15,745	
Bill Williams Mountain, Hat Allotment	2,862	Closed to grazing: site-specific NEPA decision, September 2010.
Total area withdrawn from livestock grazing through previous site-specific decisions	**60,247**	The withdrawn area includes 14,274 capable acres and 45,973 acres not capable due to steep slope, erodable soils, and low productivity.
Tentatively capable, but not suitable for livestock grazing	**14,274**	Total capable acres withdrawn from grazing due to incompatibility with desired conditions.

A suitable determination indicates that grazing is compatible with the desired conditions for the relevant portion of the plan area. It is guidance for project and activity decision making, and is not a commitment or a final decision. It does not mean that grazing will or will not occur in a particular area. The final decision to authorize livestock grazing and the determination for how lands are managed, including those that have been identified as not capable of producing forage, is made at the project/allotment level. The decisions are made following consideration site-specific environmental analysis and review analysis consistent with the National Environmental Policy Act (NEPA). As part of the NEPA analysis, condition and trend of the Kaibab NF's allotments was assessed to ensure availability of forage for all species. A summary of these evaluations was prepared and reviewed during the plan revision process and can be found in the Kaibab NF Plan Revision project record.

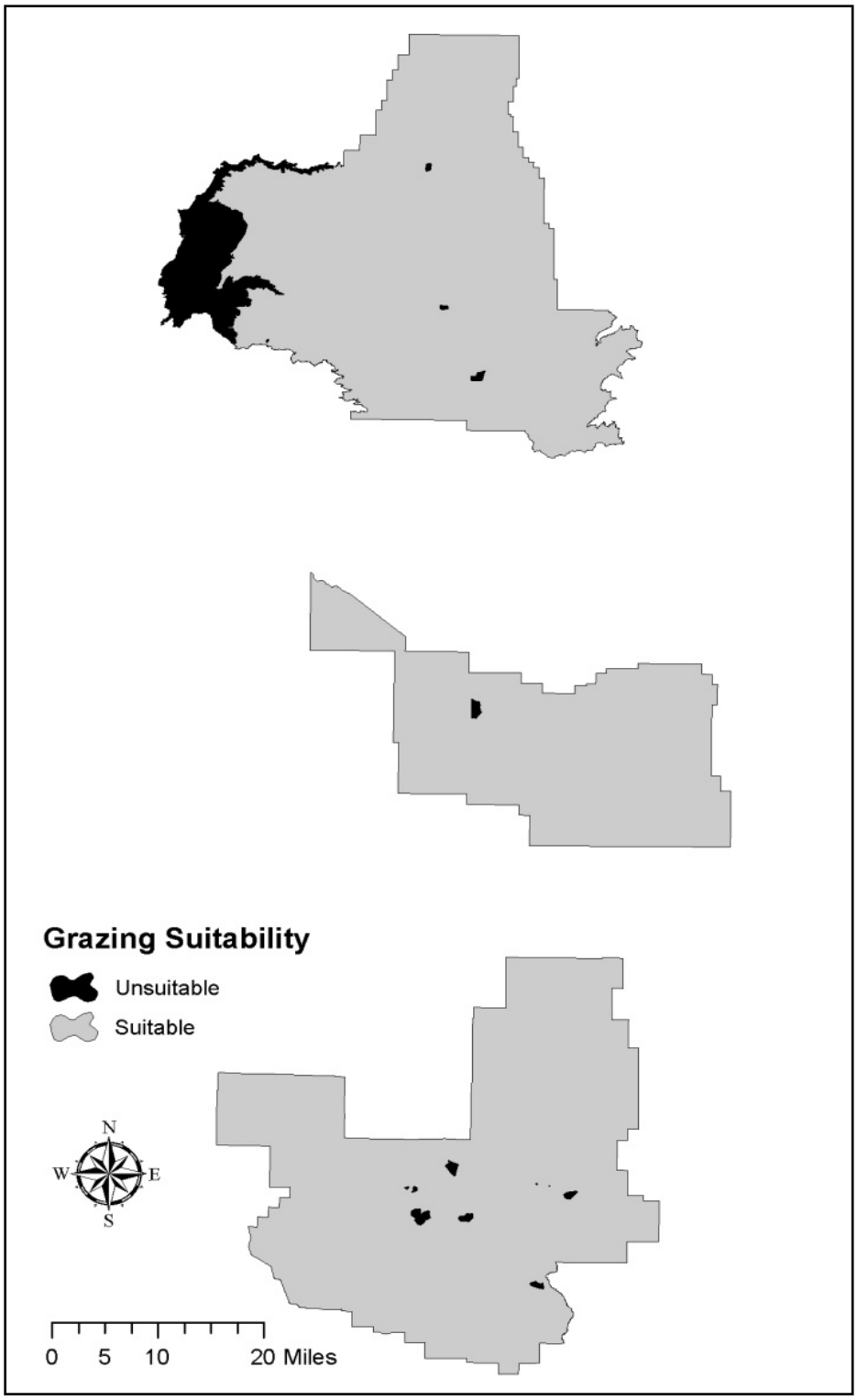

Figure 5. Kaibab NF lands suitable and unsuitable for livestock grazing

Minerals and Energy Development Suitability

Forest plan decisions can make suitable (or unsuitable) determinations for extraction or use of common variety minerals and energy (oil, gas, geothermal) resources on the Kaibab NF. Minerals are classified as leasable, salable, or locatable. Coal, oil shale, oil and gas, phosphate, potash, sodium, geothermal resources, and all other minerals that may be acquired under the Mineral Leasing Act of 1920, as amended, are referred to as leasable minerals. Common varieties of sand, stone, gravel, pumicite, and clay that may be acquired under the Materials Act of 1947 are considered saleable minerals or mineral materials.

Any minerals that are not saleable or leasable, such as gold, silver, copper, tungsten, and uranium, are referred to as locatable minerals. Locatable minerals include most metallic minerals and certain nonmetallic and industrial minerals. Locatable minerals are subject to the General Mining Law of May 10, 1872, as amended, and withdrawal decisions are outside the authority of national forest planning. The areas of the North Kaibab and Tusayan Ranger Districts that were designated as part of the Grand Canyon Game Preserve are closed to locatable mineral entry. This area of "public domain lands" was designated as a game preserve in 1906, and was set aside from mineral entry as described in the 1872 General Mining Law. In 1985, a court decision determined that the area is open to leasable minerals activities that are consistent with the character of the game preserve.

The remaining areas of the North Kaibab and Tusayan Ranger Districts were recently withdrawn from locatable mineral entry under the "Record of Decision for the Northern Arizona Withdrawal" (January 9, 2012). The "Record of Decision for the Northern Arizona Withdrawal" prevents the establishment of new mining claims on public domain lands within the Tusayan Ranger District, and the specified portions of the North Kaibab Ranger District, but would have no effect on existing valid claims. Existing valid mining claims may still be developed within the withdrawn area where valid existing rights can be proven.

The following were considered in evaluating potential changes to mineral and energy suitability:

- Solar and wind resources are being developed near the Kaibab NF and requests for development on the Kaibab NF have been received. Energy transmission was addressed in the "West-Wide Energy Corridor Environmental Impact Statement." Solar and wind generation demands and technology are rapidly changing and may need to be revisited within the plan period.
- Demand for mineral materials is likely to continue.

Table 4 displays the current status of minerals and energy resources suitability on the Kaibab NF.

Table 4. Suitability for mineral and energy activities on the Kaibab NF

Location	Suitability	Notes
Grand Canyon Game Preserve	Withdrawn	This area is withdrawn from all locatable mineral entry. It is available for saleable and leasable mineral development on a case-by-case basis and government uses as needed, for roads and facility maintenance or construction that are consistent with the purpose of the game preserve.
Kanab Creek Wilderness		Most of this wilderness was withdrawn from locatable mineral entry with designation of the Grand Canyon Game Preserve. The remaining portions of the area were withdrawn from all mineral entry with its wilderness designation.
Kendrick Mountain Wilderness		This area was withdrawn from all mineral entry with its wilderness designation.
Saddle Mountain Wilderness		This wilderness was withdrawn from locatable mineral entry with designation of the Grand Canyon Game Preserve. It was withdrawn from all mineral entry with its wilderness designation.
The remaining portions of the Tusayan Ranger District and North Kaibab Ranger District		Withdrawn from locatable mineral entry with the "Record of Decision for the Northern Arizona Withdrawal," January 9, 2012. These areas are available for saleable and leasable mineral entry and development.
Administrative, communication, and electronic sites		Most administrative sites are currently withdrawn. Note: a few are in the process of being withdrawn and have not been finalized. Administrative, communication and electronic sites that are not currently withdrawn are unavailable.
Areas of acquired lands for which the Forest Service has mineral rights	Unavailable	Determination regarding mineral rights would be made on a site-specific basis in response to proposals.
Bill Williams Watershed	Unavailable	Due to the high value of the Williams Municipal Watershed and the potential for adverse effects associated with mineral uses, this area is unavailable for mineral entry.
Solar and wind	Unavailable	There are opportunities off of the the Kaibab NF on adjacent private, tribal, and Arizona State lands. Off-Forest areas would be considered first for solar and wind development consistent with the screening process specified in FSH 2709.11, chapter 70.
All other NFS lands on the Kaibab NF	Available	Open to mineral and energy resource development consistent with the desired conditions, standards, and guidelines of this plan.

Suitability Key:

Withdrawn: Not open to locatable mineral entry except for mining claims with valid existing rights.

Available: Open to entry for locatable mineral development and saleable or leasable resources if site-specific NEPA determines it is appropriate.

Unavailable: Not open to entry for saleable or leasable mineral development. Open to locatable mineral entry.

Recreation Suitability

Recreation suitability on the Kaibab NF corresponds to the recreation opportunity spectrum (ROS) and scenery management system scenic integrity objectives (SIO). ROS is based on the premise that visitors choose specific settings for their recreation activities in order to enjoy the desired experiences. Using a classification system, seven potential classes of recreation opportunity are applied to lands on the Kaibab NF. Each class describes different outdoor recreation settings and characteristics such as size, scenic quality, type and degree of access, remoteness, level of development, social encounters, and amount of onsite management. The classes are primitive, semiprimitive nonmotorized, semiprimitive motorized, roaded natural, roaded modified, rural, and urban. By describing the existing recreation opportunities in each class, ROS helps visitors select their preferred recreation setting.

The Forest Service developed the scenery management system to provide a vocabulary and systematic approach for managing scenery in national forests. It integrates the biological, physical, and cultural elements that combine to make each landscape unique. The process involves identifying scenery components as they relate to people, mapping the components, and developing a value for aesthetics from the data gathered. Most recreation-oriented people who visit national forests have an image of what they expect to see. Application of the mapping is based upon the assumption that people value most highly the more visually attractive and naturally appearing landscapes. Scenic integrity is used to describe the degree of intactness of the scenery, and the levels include very high, high, moderate, low, and very low. Scenic integrity can also be used to describe past, present, and future landscapes.

The ROS classes and SIO levels displayed in the suitability maps (figures 6-11) indicate the desired conditions for the Kaibab NF landscape. The existing ROS and SIO may not currently meet these desired conditions, but projects are designed to maintain or improve these to meet the desired conditions.

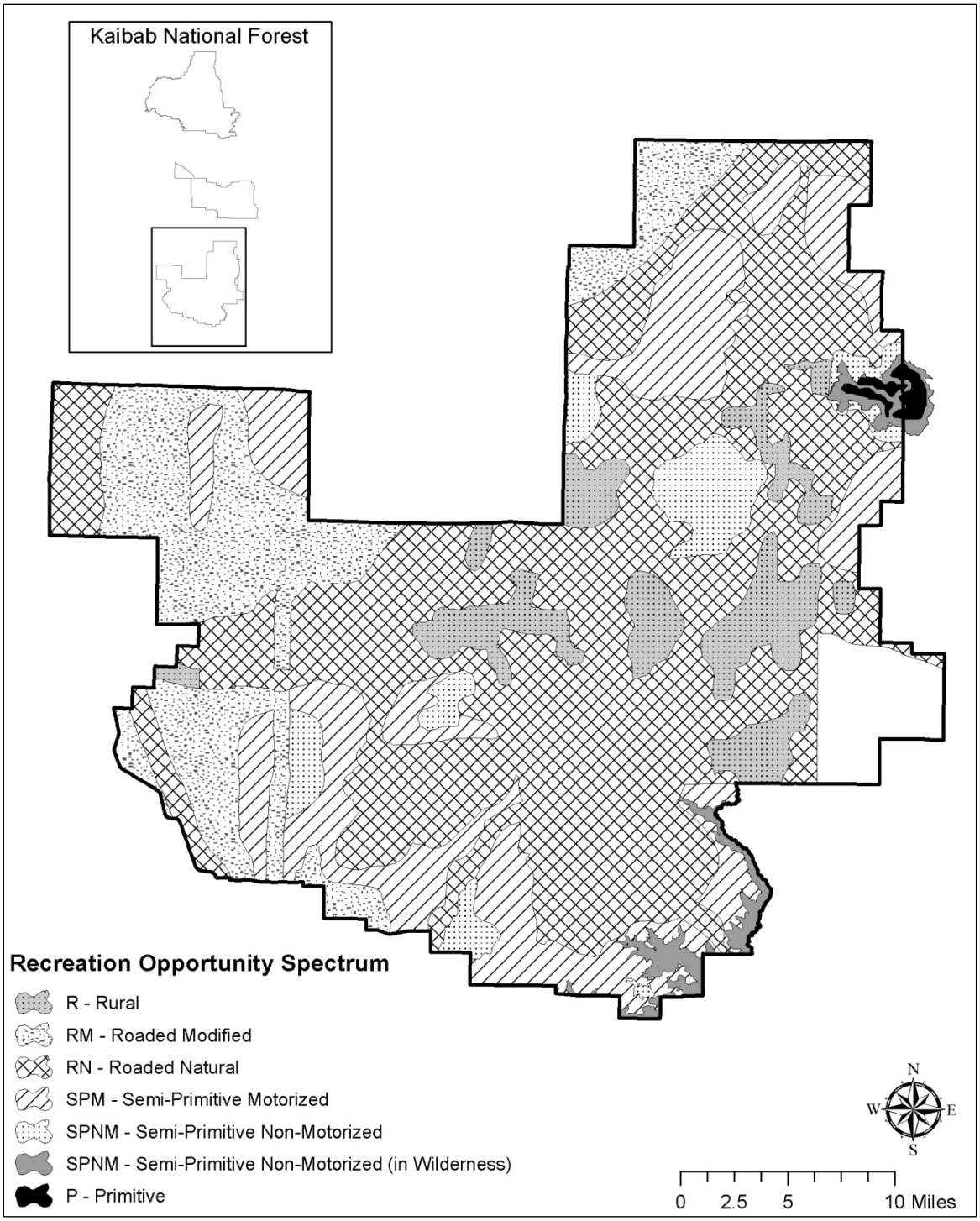

Figure 6. Recreation opportunity settings for the Williams Ranger District

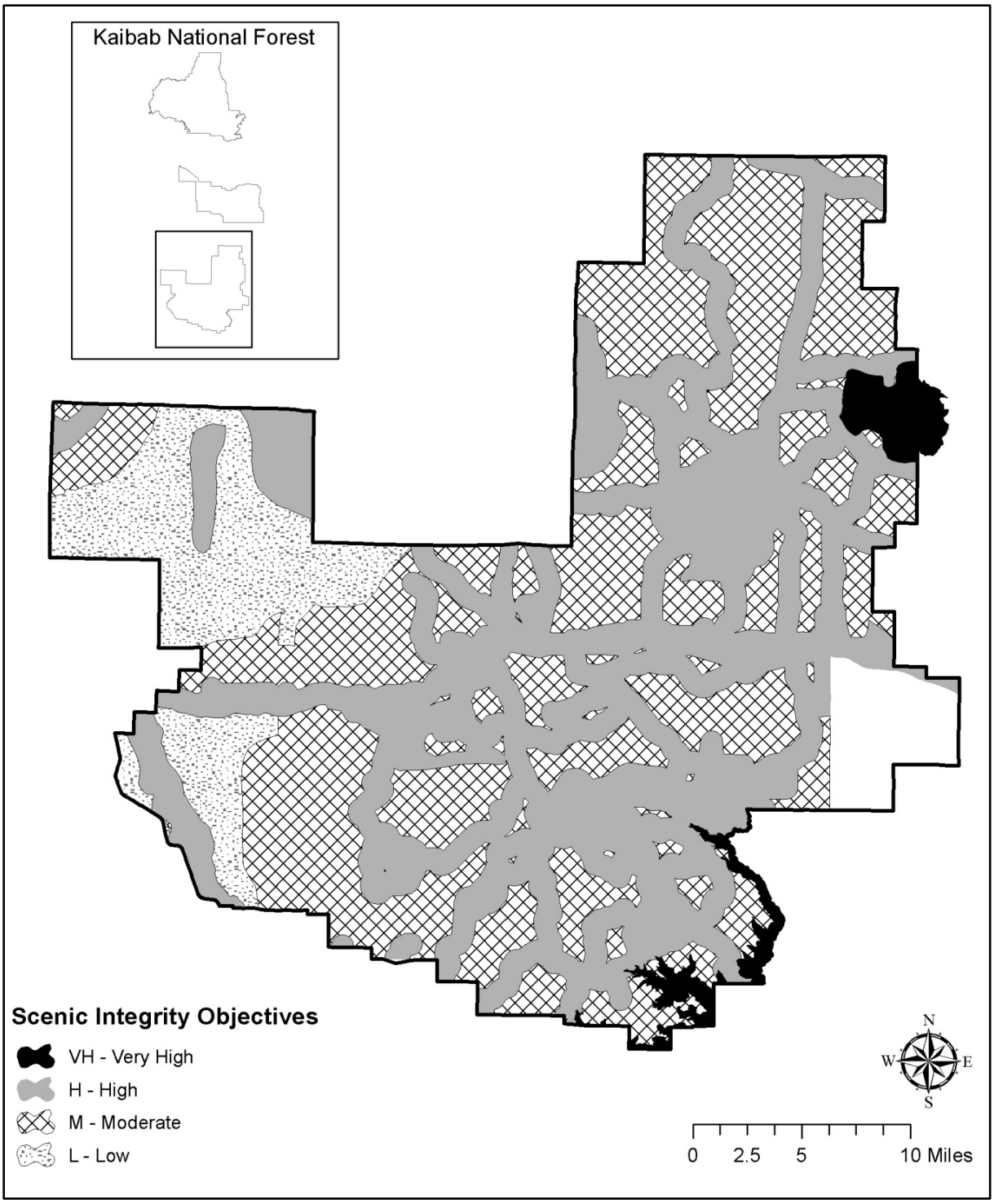

Figure 7. Scenic integrity objectives for the Williams Ranger District

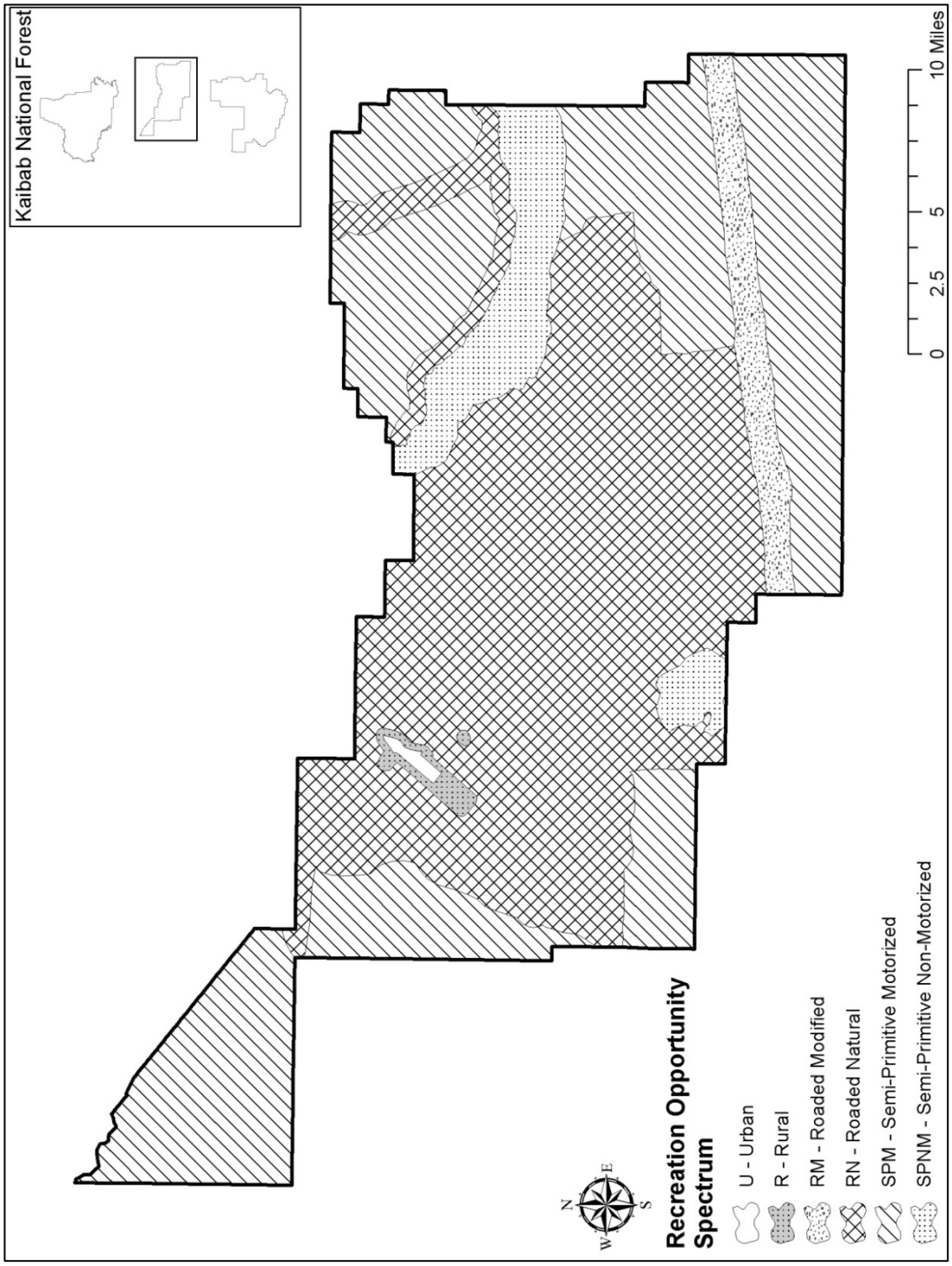

Figure 8. Recreation opportunity settings for the Tusayan Ranger District

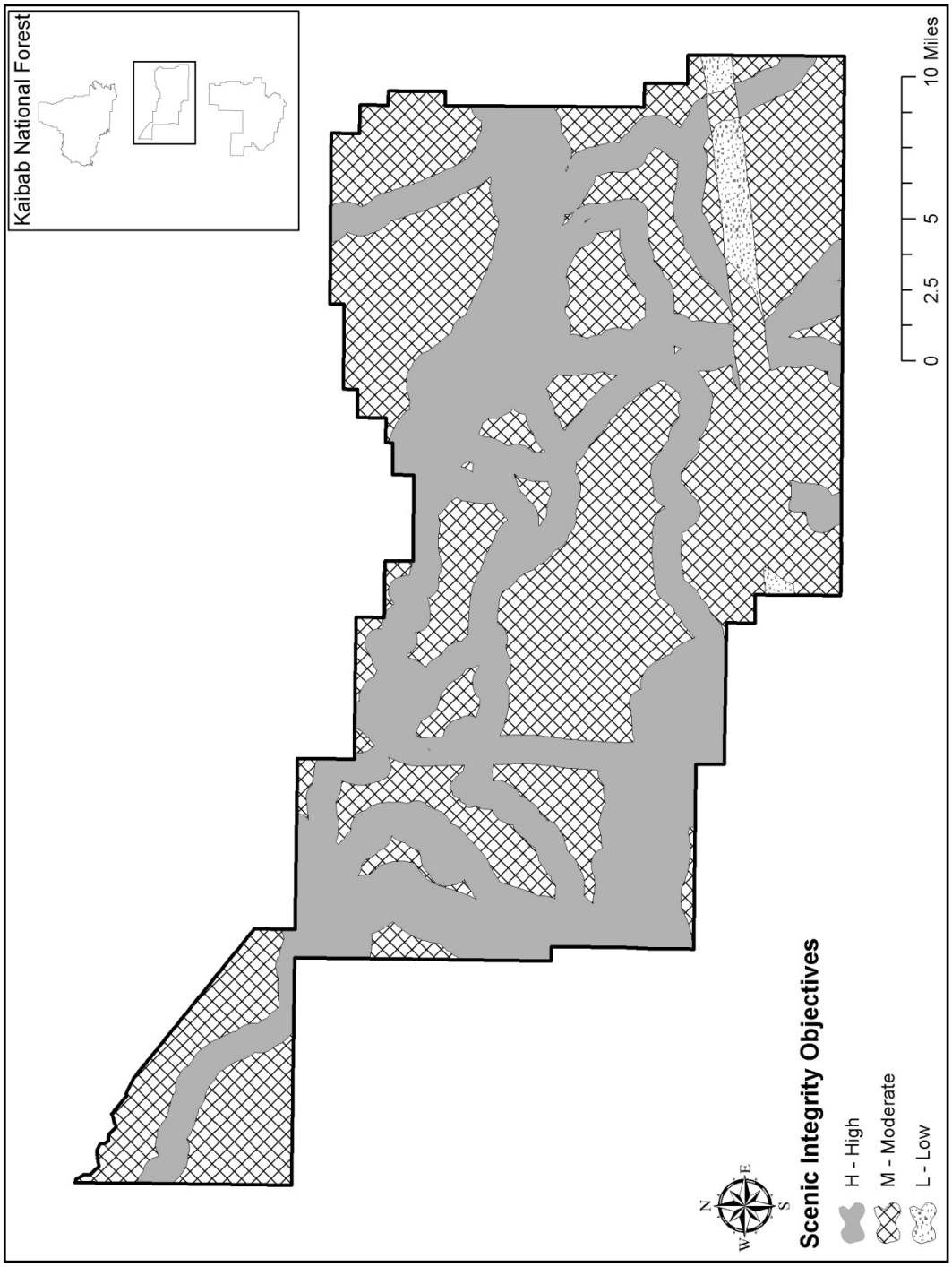

Figure 9. Scenic integrity objectives for the Tusayan Ranger District

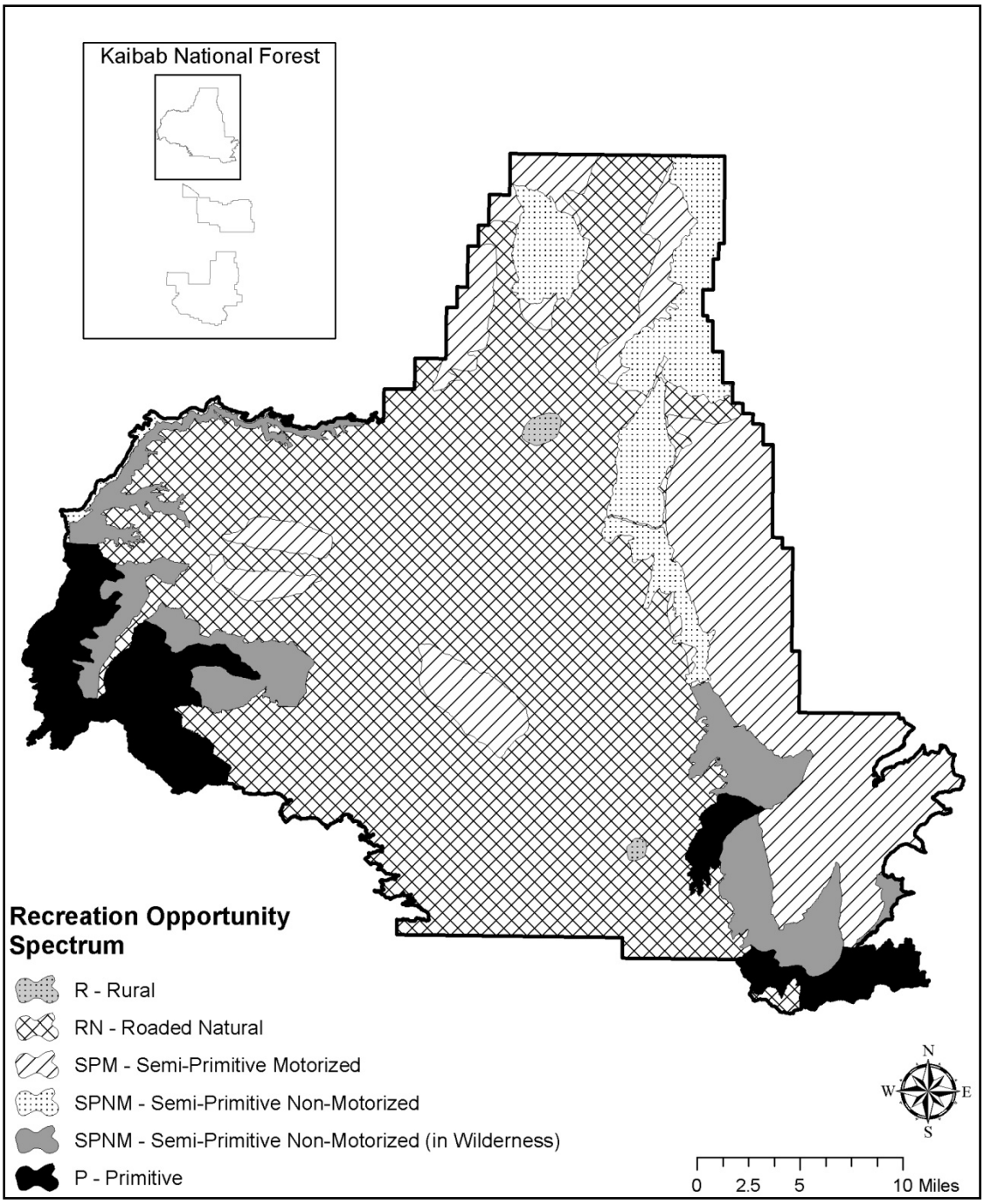

Figure 10. Recreation opportunity settings for the North Kaibab Ranger District

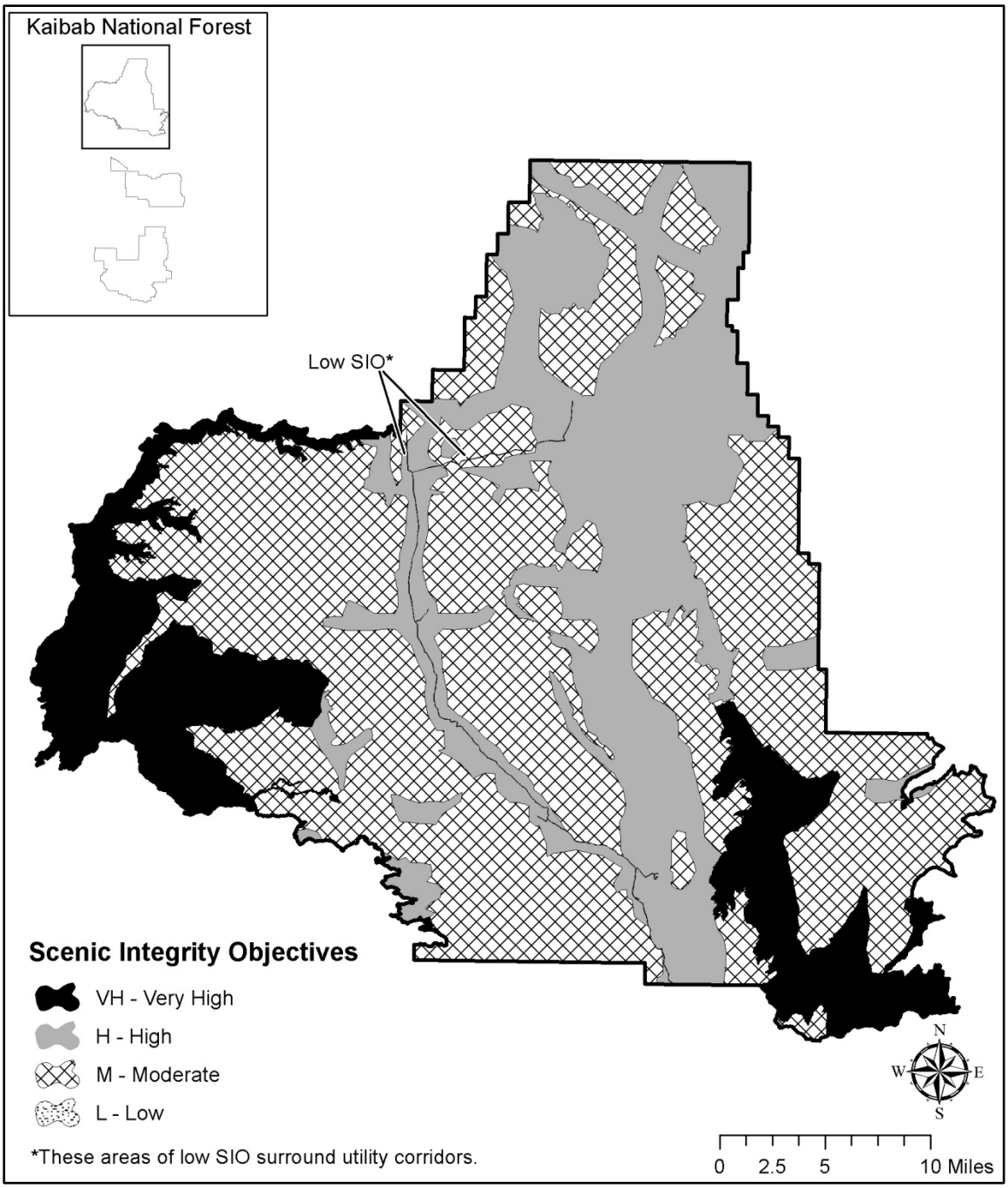

Figure 11. Scenic integrity objectives for the North Kaibab Ranger District

Chapter 5. Monitoring and Evaluation

Introduction

Monitoring and evaluation are required by the 1982 Planning Rule provisions. Monitoring and evaluation documents and reports how well a plan is being implemented, how well it is working, and if its direction is still appropriate. Evaluation examines altered conditions that result from management, identifies possible reasons desired conditions are not being met, and proposes alternative solutions. Monitoring is essential to provide information to the responsible official so he or she can decide if a change in plan components or other plan content may be needed to respond to changing conditions and issues. Monitoring is the feedback that enables adaptive management.

Monitoring and evaluation are fundamental to good program management and they:

- Provide data on project implementation and effectiveness
- Improve decision making
- Allow for accountability to stakeholders
- Help identify needed changes in management
- Inform further information needs

The monitoring plan outlines the general framework for achieving forest plan monitoring objectives. It is strategic in nature and contains specific questions that ask how well the Kaibab NF is moving toward and achieving its desired conditions and objectives within a given resource area. The monitoring plan uses a multi-scaled approach to monitor short and long-term changes. Monitoring is not completed on every activity. It does not address project level compliance monitoring, which is conducted to evaluate consistency with law, regulation, or policy, unless such monitoring answers a Forest-wide question. It is not intended for research purposes and may have varying degrees of statistical rigor.

This monitoring plan is intended to be adaptive in nature and incorporates strategies that are holistic, collaborative, and grounded in science. This approach should provide the Kaibab NF with the best chance for achieving long-term sustainability of its natural resources, as well as the natural resources of the greater landscape.

Although this monitoring plan was developed under the 1982 Planning Rule, current policy requires it be compliant with the new (2012) Planning Rule within 4 years. Section 36 CFR 219.12 (c)(1) states "…*The responsible official shall develop the plan monitoring program as part of the planning process for a new plan development or plan revision. Where a plan's monitoring program has been developed under the provisions of a prior planning regulation and the unit has not initiated plan revision under this part, the responsible official shall modify the plan monitoring program within 4 years of the effective date of this part, or as soon as practicable, to meet the requirements of this section…*" In an effort to streamline this process, this monitoring plan was developed proactively and considered many of the key monitoring components outlined under the new planning rule. As such, it includes concepts such as effectiveness monitoring, adaptive management, and the integration of local scale (e.g. plan-level) monitoring with broader landscape-level strategies (e.g. across multiple units, regions). Further, it is supportive of multi-party monitoring and intends to leverage existing data sets and the inventory and monitoring efforts of other partners and agencies. When additional changes to the monitoring plan are necessary to bring it in further compliance with the new planning rule, these

changes will be addressed through administrative corrections or plan amendments. Additional information can be found in Appendix A of the Final Programmatic Impact Statement for the 2012 Planning Rule, §219.12; Monitoring. Further guidance on monitoring program development for individual forest units can be found under Chapter 30-Monitoring, in the Draft Forest Service Land Management and Planning Handbook (FSH 1909.12).

An interdisciplinary team developed this monitoring plan to: (1) meet legal requirements, (2) be consistent with corporate data standards and protocols, and (3) address the various aspects of forest management in an integrated manner.

This chapter of the Forest Plan provides the overall monitoring strategy, which is one of three components that comprise the monitoring and adaptive framework. The three components have distinct and complimentary roles.

1. **Forest Plan Direction** provides broad, strategic guidance and specifies the monitoring requirements in the plan itself. It provides the overall monitoring strategy, including specific questions that need to be answered, what will be monitored, timetables for reporting, and other information.
2. **Monitoring and Evaluation Implementation Guide** provides specific, technical guidance. It describes how, where, and when to accomplish the monitoring prescribed in the plan and provides the specific methods, protocols, and analytical procedures. The guide is not part of the forest plan so that it may be more flexible and responsive to new information, updated procedures, emerging issues, and budgetary considerations without amending the plan.
3. **Annual Monitoring Evaluation Review** provides a regular process for reviewing recent findings and evaluating the need for modifications in the plan, monitoring plan and practices.

Monitoring Strategies

These strategies employ and build on existing methodologies and sources of information, but can be expanded and modularized to increase the robustness and comprehensiveness of data collection and processing when additional need and capacity arise. These strategies are intended to achieve statistically valid outputs through transparent data collection, processing, and analyses, as well as facilitate consistency in data collection methods by partners (e.g., adjacent landowners, stakeholders, tribes, etc.). This will foster greater efficiency, accountability, comparability of data, and the ability to better leverage monetary resources.

The Kaibab NF works with Rocky Mountain Research Station, Forest Service State and Private Forestry, and Research and Development, Northern Arizona University, as well as other partners (e.g. 4FRI collaborative) and interested organizations to assess research needs, opportunities, and methods relevant to current and future forest management. Research organizations help the Kaibab NF fill knowledge gaps and develop a better understanding of ecosystem processes, structure, pattern, and composition and additional avenues of investigation necessary to validate desired conditions and/or improve implementation practices.

Information Management

Data will be designed and collected according to appropriate data standards and entered into corporate databases such as Natural Resource Inventory System or GIS. The information can

then be accessed and analyzed to produce information products such as monitoring reports that would be available for internal and external review. These reports should provide the information necessary to make informed management decision.

Monitoring and Evaluation Implementation Guide

A more prescriptive implementation guide is being drafted that will describe "the how" in terms of specific sample designs and strategies, identify indicator variables and models to be used, and determine any appropriate target thresholds/benchmarks to be met. This guide will be tested and likely modified over time. The implementation guide is not part of the plan; rather it is supplemental information to improve effective implementation of the plan and to identify adaptive management strategies. As such, it can be adjusted as needed to improve efficiency and updated to be adaptive and responsive to address emerging issues, new science, changes to recommended survey methodologies and techniques, and fluctuations in budget without a plan amendment. The guide is being developed collaboratively with area experts and statisticians in order to reflect the best available science, while yielding statistically valid, robust, and contemporary data sets to the extent possible. The implementation guide will build off of and integrate methodologies specified in the background reports for the rapid plot monitoring design and remotely sensed tools for determining changes in forest structural conditions (Dickson et al. 2011, Ray, et al. 2012).

Monitoring Matrix

This monitoring matrix contains the plan decisions of the monitoring plan. It includes a combination of effectiveness and implementation monitoring. It is organized by five primary methods of data acquisition. Each matrix subheading is described in detail below. The order of monitoring items within each subheading follows the order of each resource area within the plan.

In many cases, data collected on one metric may help to answer several questions, improving efficiency and utility of the data. Efficiency is also achieved by leveraging existing and complimentary data sources from internal as well as external parties to the extent practicable. Frequency of data collection, evaluation, and reporting varies by resource area and monitoring question. That is, not every item identified in the matrix is monitored or reported out on every year.

Data Acquisition Methods

Specific monitoring questions require that data be gathered at multiple scales. As a result, a combination of strategies for obtaining data are used, including existing methodologies and sources of information, rigorous field assessment protocols, remote sensing techniques, and existing monitoring efforts and other sources of information. Additionally, data collected for other purposes that can be used to answer monitoring questions are specified, obtained, and evaluated as part of the monitoring plan.

Rapid Plots indicate status of key ecological attributes for a focal ecological resource at the mid to fine spatial scales, although measurements in multiple locations may provide wide spatial coverage. Data include relatively simple field based metrics. Examples include snags, down logs, large trees, presence of nonnative invasive species, and soil conditions.

Rapid plot data would be collected on key parameters using a systematic sampling framework superimposed across the entire Kaibab NF. Planned and existing projects would help guide the

plot placement process with the intent that data collected at the project level would be aggregated with other rapid plot data to make inferences at the Forest level. The Rapid Plot Monitoring Design and Statistical Guide for the Kaibab NF (Ray et al. 2012) supports the monitoring plan and provides more detailed information.

Remotely Sensed monitoring indicates status of key ecological attributes for a focal ecological resource at landscape scales and/or at coarser spatial resolution. Data sources include GIS and remote sensing imagery, which would indicate changes in land cover across the entire Kaibab NF, as well as adjacent and nearby lands. Examples of outputs include landscape composition, pattern, and fragmentation. Some data collected through rapid plots may be used to validate and improve the accuracy of remote sensing data.

Existing Sources are existing data the Kaibab NF or its partners already collect and report. Much of these data are managed under the Natural Resource Manager system, a system of database tools for managing Agency data across the Forest Service. Natural Resource Manager includes Forest Service Activity Tracking System, Infrastructure, and the Natural Resource Information System databases, among others. Data routinely collected by the Arizona Department of Environmental Quality, Arizona Game and Fish Department, and USDA Animal and Plant Health Inspection Service are other sources of existing data that can be leveraged to answer Forest-wide questions.

Interviews are largely qualitative in nature and may be subjective. These may include questions posed to resource specialists or partners or during tribal discussions. Follow-up interpretation of the results is required to obtain information.

Intensive monitoring indicates status of key ecological attributes for focal ecological resources at fine spatial scales or spatial resolution, although measurements in multiple locations can provide wide spatial coverage. Data sources might include simple to complex field-based metrics that are usually quantitative and collected within a statistical sampling design. Examples include surveys of birds to assess density levels, analyses involving specific soil and water chemistry parameters, and quantitative vegetation structure measurements.

Matrix Data Fields

Resource area: A quantitative or qualitative resource, use, or activity parameter that can be assessed, e.g., vegetation communities, wildlife species, invasive species, recreation, etc.

Monitoring question: Specific monitoring questions ensure that the information essential to measuring progress toward meeting the plan objectives and desired conditions is collected and evaluated. Monitoring questions focus on key plan components where carrying out projects and activities are planned and changes are likely to result over time.

Metric: Metrics or indicators that are key attributes for a particular resource area. Indicators were selected that are specific and measurable, and occasionally include multiple metrics. In some cases, one metric can answer several different questions. These attribute measurements can be quantitative and/or qualitative and should provide enough information to answer the monitoring question(s). Indicators should be conducive to effective and systematic repeatable monitoring with existing survey methodology and within budgetary constraints.

Driver: Monitoring drivers identify the reasons for monitoring a particular item. Drivers can be: (1) legal and regulatory requirements and Forest Service Manual direction; (2) forest plan desired conditions, goals, objectives, standards, and guidelines; (3) validation of assumptions and predictions; or (4) court rulings or legal and regulatory compliance. The matrix below lists the primary drivers associated with the forest monitoring questions; it is not an exhaustive list.
Measurement interval: Describes how often monitoring information is collected. This varies based on the resource area, monitoring drivers, and questions.

Evaluation and reporting interval: Describes how often monitoring information is evaluated and reported. The initial data will be assessed to establish a "baseline" against which change can be compared. Monitoring reports will be prepared on an annual basis with a comprehensive review occurring approximately every five years. This would allow the Kaibab NF to evaluate the overall monitoring program and management actions and to identify any conditions that would trigger a change in management or prompt further investigation, either internally or externally. This evaluation would allow the Kaibab NF to add, modify, or delete existing questions no longer needed in the monitoring plan. It would also assess plan components and implementation effectiveness, and whether or not the Kaibab NF is achieving and maintaining desired conditions.

Precision and Reliability: Two categories of precision and reliability are appropriate at the plan scale:

> **Class A** (Quantitative) are methods appropriate for modeling or quantitative measurement. Results have a high degree of repeatability, reliability, accuracy, and precision.
>
> **Class B** (Qualitative) are methods based on project records, personal communications, ocular estimates, pace transects, informal visitor surveys, and similar types of assessments. The degree of repeatability, reliability, accuracy, and precision are not as high as Class A methods, but they still provide valuable information and are more appropriate for some resource areas.

Table 5. Matrix for the Kaibab NF Monitoring Plan

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
RAPID PLOT							
01	**Ponderosa Pine and Frequent Fire Mixed Conifer** **Soils and Watersheds,** **Threatened, Endangered and Sensitive Species**	Are snags, coarse woody debris, downed logs and large old trees at desired levels at the midscale (100-1,000 acre average)?	Number per acre	**Ponderosa Pine Midscale Desired Condition (DC)s:** Snags 18 inches d.b.h. or greater average 1 to 2 snags per acre. Snags and green snags of variable size and form are common. Downed logs (greater than12 inches diameter at mid-point and greater than 8 feet long) average 3 logs per acre. Coarse woody debris greater than 3 inches in diameter (including downed logs) ranges from 3 to 10 tons per acre (Ponderosa Pine). Coarse woody debris, including downed logs, ranges from 5 to 15 tons per acre (Frequent Fire Mixed Conifer). **Ponderosa Pine, Frequent Fire Mixed Conifer Landscape scale DCs:** Old growth occurs throughout the landscape, generally in small areas as individual old growth components, or as clumps of old growth. Old growth components include old trees, snags, coarse woody debris, and structural diversity. The location of old growth shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality). **Soils DC:** Logs and other woody materials are distributed across the surface to maintain soil productivity. **MSO Recovery Plan**	1-5	2-5	A
02	**Ponderosa Pine and Frequent Fire Mixed Conifer** **T&E**	Is the fuel loading within the desired range?	Tons per acre	**Ponderosa Pine Midscale DC:** Coarse woody debris greater than 3 inches in diameter (including downed logs) ranges from 3 to 10 tons per acre. **Frequent Fire Mixed Conifer Midscale DC:** Coarse woody debris, including downed logs, ranges from 5 to 15 tons per acre.	1-5	2-5	A

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
03	**Soils and Watersheds**	What is the percent of effective ground cover? What is the proportion of live and dead vegetation, rock, and bare ground?	Percent cover	**Soils DC:** Vegetative ground cover is well distributed across the soil surface to promote nutrient cycling and water infiltration. **LandscapePonderosa Pine, Frequent Fire Mixed Conifer, Mesic Mixed Conifer/Spruce Fir Finescale DC:** Organic ground cover and herbaceous vegetation provide for soil and moisture infiltration, and contribute to plant and animal diversity and to ecosystem function.	1-5	2-5	A
04	**Soils and Watersheds**	Are the effects of forest management resulting in changes to the productivity of soils (e.g. evidence of platy structures, pedastalling of vegetation or rock, rills)?	Presence/ absence	**Soil DC:** Soils can readily absorb, store, and transmit water vertically; accept, hold, and release nutrients; and resist erosion. **National Forest Management Act**, 1976 (16 U.S.C. 1604(g)(3)(C))	1-5	2-5	A/B
05	**Soils and Watersheds**	Is there downcutting and/or embeddedness in ephemeral drainages?	Presence/ absence	**Watershed DC:** Vertical down cutting and embeddedness are absent in drainages.	1-5	2-5	B
06	**Nonnative Invasive Species**	What is the percent cover of noxious weeds[1] by species?	Percent cover	**Nonnative Invasive DC:** Invasive species are contained and/or controlled so that they do not disrupt the structure or function of ecosystems or impact native wildlife. **Nonnative Invasive Guideline (GD):** New populations should be detected early, monitored, and treated as soon as possible.	1-5	2-5	A

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
REMOTELY SENSED							
07	**Ponderosa Pine and Frequent Fire Mixed Conifer**	How many acres of the Kaibab NF is in an uneven aged open state, at the midscale (above 100 acres)?	Acres	**Ponderosa Pine and Frequent Fire Mixed Conifer Landscape DC:** The ponderosa pine/frequent fire mixed conifer forest vegetation community is a mosaic of forest conditions composed of structural stages ranging from young to old trees. The forest is generally uneven aged and open. **Frequent Fire Mixed Conifer DCs:** The frequent fire mixed conifer forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. Forest appearance is variable, but generally uneven-aged and open; occasional patches of even-aged structure are present. **Frequent Fire Mixed Conifer and Ponderosa Pine Midscale DC:** Forest conditions in some areas contain 10 to 20 percent higher basal area in mid-aged to old tree groups than in the general forest (e.g. goshawk post-fledging family areas, MSO nesting/roosting habitat, drainages, and steep north-facing slopes). **MSO Recovery Plan**	3-5	3-5	A/B

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
08	**Ponderosa Pine and Frequent Fire Mixed Conifer**	How many acres are predicted to support active crown fire as modeled under typical peak fire danger conditions at the midscale?	Acres	**Ponderosa Pine and Frequent Fire Mixed Conifer Midscale DC:** Fires burn primarily on the forest floor and typically do not spread between tree groups as crown fire. **Ponderosa Pine Objective (OBJ):** To reduce the potential for active crown fire in ponderosa pine communities: Mechanically thin 11,000 to 19,000 acres annually; Burn an average of 13,000 to 55,000 acres annually using a combination of prescribed fire and naturally ignited wildfires. **Frequent Fire Mixed Conifer OBJs:** Burn an average of 1,000 to 13,000 acres annually using prescribed fire and/or naturally ignited wildfires. Mechanically thin 1,200 to 2,100 acres per year.	3-5	3-5	A
09	**Ponderosa Pine and Frequent Fire Mixed Conifer**	Is the stand density within a range that will allow for a robust understory?	Acres, SDI^2	**Finescale DC:** Organic ground cover and herbaceous vegetation provide protection for soil and moisture infiltration, and contribute to plant and animal diversity and to ecosystem function.	3-5	3-5	A/B

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
10	**Ponderosa Pine, Mixed Conifer, Spruce fir, and Pinyon-juniper Communi-ties.**	How many acres are at high risk for insect outbreaks?	Acres, SDI	**Ponderosa Pine Landscape DC:** The landscape is a functioning ecosystem that contains all components, processes, and conditions associated with endemic levels of disturbances (e.g. fire, dwarf mistletoe, insects, diseases, lightning, drought, and wind). Forest vegetation conditions are resilient to the frequency, extent, and severity of disturbances and climate variability. **Frequent Fire Mixed Conifer Landscape DC**: The landscape is a functioning ecosystem that contains all components, processes, and conditions that result from endemic levels of disturbances (e.g., fire, insects, diseases, and wind). **Mesic Mixed Conifer/Spruce Fir Landscape DCs**: The forest landscape is a functioning ecosystem that contains all components, processes, and conditions that result from endemic levels of disturbances (e.g. insects, diseases, wind, snow, and fire), including snags, downed logs, and old trees. The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances and climate variability. **Pinyon-juniper Communities DC**: The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances (e.g. insects, diseases, and fire) and climate variability.	1-2	2-5	A/B

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
11	**Ponderosa Pine and Frequent Fire Mixed Conifer**	What is the total area within the desired range for basal area and openings?	BA, OpenCanopy	**Ponderosa Pine Midscale DCs:** Basal area within forested areas generally ranges from 20 to 80 sq ft/acre, with larger trees (i.e. >18 inches in diameter) contributing the greatest percent of the total basal area. Interspaces with native grass, forb, and shrub vegetation are variably shaped and typically range from 10 to 70 percent, with the more open conditions typically occurring on less productive sites. **Frequent Fire Mixed Conifer Midscale DCs:** Basal area within forested areas generally ranges from 30 to 100 sq ft/acre, with larger trees contributing the greatest percent of the total basal area. Interspaces with native grass, forb, and shrub vegetation typically range from 10 to 50 percent of the area.	3-5	3-5	A
12	**Aspen**	What is the areal extent and configuration of aspen on the Kaibab NF?	Acres	**Aspen DC:** Aspen occurs in natural patterns of abundance and distribution at levels similar to or greater than those at the time of plan approval.	3-5	3-5	A
13	**Grasslands**	What percent of the grassland PNVT has <10 percent canopy cover?	Percent cover	**Grassland DC:** Tree and shrub canopy cover are each less than 10 percent.	3-5	3-5	A/B
14	**Wildlife**	Does habitat configuration provide functional connectivity for pronghorn?	Suitability Index[3]	**Wildlife DCs:** Interconnected forest and grassland habitats allow for movement of wide ranging species. Habitat configuration and availability allows wildlife populations to adjust their movements (e.g. seasonal migration, foraging, etc.) in response to climate change and promote genetic flow between wildlife populations.	3-5	3-5	A/B

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
EXISTING SOURCES							
15	**Fire Adapted Ecosystems**[25]	How many acres were burned with desired and undesired fire behavior and effects?	Acres	**Ponderos Pine and Frequent Fire Mixed Conifer Finescale DC:** Fires generally burn as surface fires, but single tree torching and isolated group torching is not uncommon. **Ponderos Pine and Frequent Fire Mixed Conifer Midscale DC:** Fires primarily burn on the forest floor and typically do not spread between tree groups as crown fire. **Ponderos Pine and Frequent Fire Mixed Conifer Landscape DC:** Fire and other disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris loads, and nutrient cycling. Frequent, low severity fires (Fire Regime I) occur across the entire landscape with a return interval of 0 to 35 years.	1-2	5	A
16	**Fire Adapted Ecosystems**	How many acres were treated with mechanical thinning by PNVT?	Acres	**Ponderosa Pine OBJ:** To reduce the potential for active crown fire in ponderosa pine communities: Mechanically thin 11,000 to 19,000 acres annually. **Frequent Fire Mixed Conifer OBJ:** Mechanically thin 1,200 to 2,100 acres per year. **Grasslands OBJ:** Reduce tree density to less than 10 percent on 5,000 to 10,000 acres of historic grasslands annually.	1-2	2-5	A

[25]Fire adapted ecosystems include pinyon-junper, ponderosa pine, mixed conifer forests, grasslands, Gambel oak wodlands, and some sagebrush shrublands.

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
17	**Fire Adapted Ecosystems**	How many acres of conifer species were planted? Were they successful?	Acres	**Activies Following Large-Scale Disturbance OBJ:** Plant 300 to 700 acres annually **1982 Planning Rule:** 219.12	1-5	2-5	A/B
18	**Aspen (Tusayan and Williams Ranger Districts)**	What was the total area of aspen fenced?	Acres	**Aspen OBJ:** Fence 200 acres of aspen within 10 years of plan approval.	1-2	2-5	A
19	**Aspen**	How many acres treated for conifer encroachment?	Acres	**Aspen OBJ:** Reduce conifer encroachment on 800 acres of aspen within 10 years of plan approval.	1-2	2-5	A
20	**Grasslands**	What is the relative composition and cover of grasslands?	Frequency	**Grassland DCs:** Vegetation is dominated by herbaceous plants composed of a mix of native grasses and forbs. The structure, composition, and distribution of vegetation are within the range of natural variability and occur in natural patterns of abundance and diversity, which may vary depending on soil type and microclimate. Organic litter varies between 30 and 50 percent of the ground cover. Vegetation composition will average 40 to 60 percent grass, and 10 to 30 percent forbs. Understory vegetation reflects the site potential.	1-5	2-5	A/B

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
21	**Grasslands**	How many miles of fence were modified for pronghorn?	Miles	**Grasslands OBJ:** Modify fences and/or install crossings to facilitate pronghorn movement on 50 miles of fence within 10 years of plan approval.	1-2	2-5	A
22	**Ponderosa Pine, Frequent fire Mixed Conifer, Mesic Mixed Conifer/Spruce-fir, and Pinyon-juniper**	What is the acreage of outbreaks of insects and disease? Is their a direct corrlation between insect outbreaks and changing weather patterns?	Acres	**Ponderosa Pine Landscape DC**: The landscape is a functioning ecosystem that contains all components, processes, and conditions associated with endemic levels of disturbances (e.g. fire, dwarf mistletoe, insects, diseases, lightning, drought, and wind). Forest vegetation conditions are resilient to the frequency, extent, and severity of disturbances and climate variability. **Pinyon-juniper Communities DC**: The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances (e.g. insects, diseases, and fire) and climate variability.	1-2	2-5	A
23	**Wildlife (MIS[4])**	What is the estimated population trend of pronghorn?	Trend	**FSM Policy:** Population trends of the management indicator species will be monitored and relationships to habitat changes determined. This monitoring will be done in cooperation with state fish and wildlife agencies to the extent practicable. **1982 Planning Rule: 219.19**	1-2	2-5	A/B
24	**Nonnative Invasive Species**	What is the areal extent of priority nonnative invasive plants on the Kaibab NF?	Acres	**Nonnative Invasive Species GD:** New populations should be detected early, monitored, and treated as soon as possible.	1-2	2-5	A
25	**Nonnative Invasive Species**	How many acres of invasive plants were treated?	Acres	**Nonnative Invasive Species OBJ:** Treat 2,000 to 3,000 acres invaded by nonative plants annually.	1-2	2-5	A

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
26	**Natural Waters**	How many springs were protected and restored?	Count	**Natural Waters OBJ:** Protect and/or restore at least 10 individual springs within 5 years of plan approval.	1-2	2-5	A
27	**Wetlands/ Cienegas**	How many acres of wetlands were restored?	Acres	**Wetlands/Cienegas OBJ:** Restore native vegetation and natural water flow patterns on at least 6 acres of wetlands within 5 years of plan approval.	1-2	2-5	A
28	**Soils and Watersheds**	Are there any water bodies not meeting Arizona water quality standards?	Count	**Watershed DC:** Water quality meets or exceeds State of Arizona or Environmental Protection Agency water quality standards for designated uses. Water quality meets critical needs of aquatic species.	2-5	2-5	A
29	**Air Quality**	How many days did forest activities contribute to exceeding State standards for visibility and public health?	Count	**Air Quality DC:** Air quality meets or surpasses all state and federal ambient air quality standards.	1-2	2-5	A
30	**Recreation**	How many acres of the Kaibab NF had a change in ROS or SMS reclassification?	Visitor Use	**Recreation DCs:** A wide spectrum of high-quality recreation settings exists. Users have access to a variety of developed and dispersed opportunities. The Kaibab NF provides sustainable recreation consistent with public demand. Use levels are compatible with other resource values. User conflicts are infrequent.	1-2	2-5	B
31	**Recreation**	How many miles of trails were maintained to standard?	Miles	**Recreation DCs:** Recreation use levels are compatible with other resource values.	1-2	2-5	A

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
32	**Cultural Resources**	How many acres of non-project related cultural resource surveys were conducted?	Acres	**Cultural Resource OBJ:** Non-project related cultural resource survey (Section 110 survey) is conducted in areas with a high likelihood of historic properties on at least 200 acres per year.	1-2	2-5	A
33	**Forestry and Forest Products**	How many acres of suitable timberlands were managed (TSI, harvest, etc.) for timber production?	Acres	**National Forest Management Act (1976)**	1-2	2-5	A
34	**Forestry and Forest Products**	Have much wood was offered?	CCF[5]	**Forestry and Forest Products DCs:** Wood products (e.g., wood pellets for home and industrial heating, oriented strand board, animal bedding, wood moulding, pallets, structural lumber, firewood, posts, poles, biomass for electricity.) are available to businesses and individuals in a manner that is consistent with other desired conditions on a sustainable basis within the capacity of the land. A sustainable supply of wood is available to support a wood harvesting and utilization industry of a size and diversity that can effectively and efficiently restore and maintain the desired conditions for ponderosa pine and frequent fire mixed conifer communities.	1-2	2-5	A
35	**Forestry and Forest Products**	How many direct jobs does the Kaibab NF support/provide from harvesting and utilization of wood products?	Number of jobs	**Forestry and Forest Products DC:** A sustainable supply of wood is available to support a wood harvesting and utilization industry of a size and diversity that can effectively and efficiently restore and maintain the desired conditions for ponderosa pine and frequent fire mixed conifer communities.	2-5	2-5	A

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
36	**Forestry and Forest Products**	Have there been significant investments in the wood harvesting and utilization infrastructure in the operating area?	Production capacity	**Forestry and Forest Products DC:** A sustainable supply of wood is available to support a wood harvesting and utilization industry of a size and diversity that can effectively and efficiently restore and maintain the desired conditions for ponderosa pine and frequent fire mixed conifer communities.	2-5	2-5	B
37	**Forestry and Forest Products**	What was the average cost per acre to the Forest Service for mechanical treatments?	Dollars per acre	**National Forest Management Act (1976)**	2-5	2-5	A
38	**Forestry and Forest Products**	What is the ratio of costs to revenues for mechanical thinning activities?	Cost: revenue	**National Forest Management Act (1976)**	2-5	2-5	A
				INTERVIEWS			
39	**Ponderosa Pine, Mixed Conifer, Spruce-fir, and Pinyon-juniper Communities**	Were there any incidences of insect outbreaks in recently treated areas? If so, where?	Presence/ absence, location	**National Forest Management Act (1976)**	1-2	2-5	A/B

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
40	**Ponderosa Pine, Mixed Conifer, Spruce-fir, and Pinyon-juniper Communi-ties.**	What was the median and maximum size openings created through implementation of precribed mechanical treatments?	Acres	**Ponderosa Pine and Frequent Fire Mixed Conifer Finescale DC:** Regeneration openings occur as a mosaic and are similar in size to nearby groups. **1982 Planning Rule: 219.12**	1-2	2-5	A
41	**Pinyon-Juniper Woodlands**	Was a robust crop of pinyon nuts produced on any of the districts?	Presence/ absence, location	**Pinyon-Juniper DC:** A robust crop of pinyon pine nuts is regularly produced.	1-2	5	B
42	**Recreation**	Did we receive any comments that reflect visitor satisisfaction? Were there common themes?	Yes or no, themes.	**Recreation DCs:** User conflicts are infrequent. Service centers such as district offices, visitor information centers, developed campgrounds, and other staffed recreation sites provide information and services in communities and along primary forest access corridors and scenic byways. Front-country areas are safe, orderly, and capable of supporting moderate to high visitor use.	1-2	2-5	B
43	**Wilderness**	Were the wilderness trails and campsites monitored? What were the results?	Yes or no; findings	**Wilderness OBJs:** Inspect and maintain at least 10 percent of wilderness trails and signs annually. Monitor 10 percent of wilderness campsites each year.	1-2	2-5	B

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
44	**Recreation and Transpor-tation**	Are there areas of the Kaibab NF where recreation or vehicle use is causing detrimental resource effects that are in need of management? Where is it occurring?	Presence/ absence, location	**Recreation DCs:** A wide spectrum of high-quality recreation settings exists. Users have access to a variety of developed and dispersed opportunities. The Kaibab NF provides sustainable recreation consistent with public demand. Use levels are compatible with other resource values. **Transportation DCs:** Roads and culverts do not contribute to headcuts or downcuts in ephemeral drainages. Roads allow for safe and healthy wildlife movement in areas of human development. Vehicular collisions with animals are rare.	2-5	2-5	A/B
45	**Cultural Resources**	Are cultural resources being protected in place?	Yes or no	**Cultural Resource DC**: Cultural resources, including known traditional cultural properties, are preserved, protected, or restored.	1-2	2-5	B
46	**Livestock Grazing**	Are livestock numbers balanced with forage capacity on each allotment?	Yes or no	**Livestock Grazing DCs:** Grasses and forbs provide adequate forage for permitted livestock. Livestock use is consistent with other desired conditions.	1-2	1-5	B
47	**Tribal Traditional and Cultural Uses**	Are plant species of known medicinal and cultural value being depleted?	Yes or no	**Tribal Traditional and Cultural Use DCs:** Traditional tribal uses such as the collection of medicinal plants and wild plant foods are valued as important uses. Traditionally used resources are not depleted and are available for future generations.	1-2	2-5	B

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
48	**Arizona Bugbane Botanical Area, Threatened, Endangered, and Senstive Species**	Were the monitoring requirements met as identified in the AZ Bugbane conservation agreement?	Yes or no	**Bugbane Botanical Area DCs:** Arizona bugbane has a sustainable population and is at low risk for extirpation. **Other**: Arizona Bugbane Conservation Agreement	5	5	B
49	**Pediocactus Conserva-tion Area,**	Were the monitoring requirements met as identified in the Pediocactus conservation agreement?	Yes or no	**Pediocactus Conservation Area DC:** Paradine plains cactus (*Pediocactus paradinei)* has a sustainable population and is at low risk for extirpation. **Other**: Pediocactus Conservation Agreement	5	5	B
50	**Timber Suitability**	Were there any events or changed circumstances that would indicate a potential change to timber suitability?	Acres of suitable timber lands	**1982 Planning Rule:** 219.12	2-5	2-5	A/B
				INTENSIVE			
51	**Aspen**	Is aspen regenerating and becoming established in treated areas?	Regener-ation and recruit-ment	**Aspen DCs:** Aspen is successfully regenerating and recruiting into older and larger size classes. Size classes have a natural distribution, with the greatest number of stems in the smallest classes. Aspen occurs in natural patterns of abundance and distribution at levels similar to or greater than those at time of plan approval.	2-5	5	A/B

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
52	**Natural and Constructed Waters**	What is the functional condition of the lakes and wetlands on the Kaibab NF?	PFC[6]	**Natural Waters DC:** Water levels, flow patterns, groundwater recharge rates, and geochemistry are similar to reference conditions. **Constructed Waters DC:** Reservoirs maintain high water quality for parameters such as temperature, pH, and dissolved oxygen, and water levels are within the seasonal range of variable conditions.	3-5	5	A/B
53	**Natural Waters**	In treated/ protected areas, are waterflow patterns and vegetation intact?	Yes or no	**Natural Waters DC:** Water levels, flow patterns, groundwater recharge rates, and geochemistry are similar to reference conditions.	2-10	2-10	B
54	**Wildlife (MIS)**	What is the estimated population trend for Graces warbler, western bluebird and ruby-crowned kinglet?	Trend	**FSM Policy**: Population trends of the management indicator species will be monitored and relationships to habitat changes determined. This monitoring will be done in cooperation with state fish and wildlife agencies to the extent practicable. **1982 Planning Rule: 219.19**	1-5	5-10	A/B

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
	Wildlife	What is the status of ruby-crowned kinglet?	Occupancy	**Priority Need for Change**: Modify stand structure and density towards reference conditions and restore historic fire regimes. **Frequent Fire Mixed Conifer DCs (Fine-scale):** Trees typically occur in irregularly shaped groups and are variably spaced with some tight clumps. Trees within groups are of similar or variable ages, often containing more than one species. Crowns of trees within mid-aged and old groups are interlocking or nearly interlocking. **(Mid-scale):** The frequent fire mixed conifer forest vegetation community is characterized by variation in the size and number of tree groups depending on elevation, soil type, aspect, and site productivity. Forest appearance is variable, but generally uneven-aged and open; occasional patches of even-aged structure are present. The more biologically productive sites contain more trees per group and more groups per area. Basal area within forested areas generally ranges from 30 to 100 square feet per acre, with larger trees contributing the greatest percent of the total basal area.	1-5	5-10	A/B
55	**Threatened,Endangered and Sensitive Species**	Are Mexican spotted owls present in PACs?	Presence/absence	**Mexican Spotted Owl Recovery Plan**	1-5	2-5	B

No.	Resource Area	Monitoring Question	Metric	Driver (desired conditions, objectives, policy, etc.)	Measure-ment Interval (years)	Evaluation/ Report Interval (years)	Precision
56	**Threatened Endangered and Sensitive Species**	What is the population trend of *Pediocactus peeblesianus* var. *fickeisenii*?	Trend	**FSM 2670:** Determine distribution, status, and trend of threatened, endangered, proposed, and sensitive species and their habitats on Forest lands.	1-5	2-5	A/B
57	**Double A Wild and Free Roaming Burro Territory**	What is the estimated burro population within the area?	Count	**Double A Wild and Free Roaming Burro Territory DC:** A biologically sound and genetically viable burro population is in balance with native wildlife, permitted livestock, and other resource values. **Other:** Wild Free-Roaming Horses and Burros Act of 1971: Forest Service Handbook sections 2263.1 Territory Plans and 2265.3 - Removal of Excess Animals.	3-5	3-5	B

Key: [1] Noxious weed is a legal term applied to plants or plant parts regulated by Federal and State laws. Arizona Administrative Codes R3-4-244, R3-4-245 (Arizona Department of Agriculture 1999) regulate certain invasive species in the state: "A noxious weed is defined as any species of plant that is detrimental or destructive and difficult to control or eradicate and includes plant organisms found injurious to any domesticated, cultivated, native, or wild plant."

[2] Stand density index (SDI) is a relative measure of stand density that converts a stand's current density into a density at a reference size (Reineke 1933).

[3] Based on connectivity modeling (Hurteau 2010)

[4] Management indicator species

[5] CCF: Wood volume (hundred cubic feet)

[6] Proper functioning condition: a methodology for assessing the physical function of riparian and wetland areas.

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Glossary and Acronyms

Glossary

Adaptive management is a system of management practices based on clearly identified intended outcomes and monitoring to determine if management actions are meeting those outcomes. If not, adaptive management facilitates management changes that will best ensure that those outcomes are met or reevaluated. Adaptive management stems from the recognition that knowledge about natural systems is sometimes uncertain.

All lands is the concept that ecosystems transcend land ownership boundaries, thus, effective land and resource management requires cooperation and collaboration among the Forest Service, other land managing agencies, tribes, and private landowners. This plan was developed using an approach whereby plan components were developed considering the greater landscape and the Kaibab NF's ecological, social, and economic role.

Age class is defined as trees that originated within a relatively distinct range of years. Typically the range of years is considered to fall within 20 percent of the average natural maturity (e.g., if 100 years is required to reach maturity, then there would be five 20-year age classes).

Basal area is the cross-sectional area at breast height (4.5 feet above the ground) of trees, measured in square feet. Basal area is a way to measure how much of a site is occupied by trees. The cross-sectional area is determined by calculating the tree's radius from its diameter (diameter/2 = radius) and using the formula for the area of a circle (π x radius^2 = cross-sectional area). Basal area per acre is the summation of the cross-sectional area of all trees in an acre or in a smaller plot used to estimate basal area per acre. Diameter at root collar (defined below) is used to calculate the cross-sectional area of multi-stemmed trees such as juniper and oak.

Browse is either: (1) the part of shrubs, half shrubs, woody vines, and trees available for animal consumption; or (2) to search for or consume browse. Interagency Technical Reference 1734-4 Sampling Vegetation Attributes. 1999 (ITR 1734-4).

Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer.

Clump refers to a tight cluster of two to five trees of similar age and size originating from a common rooting zone that typically lean away from each other when mature. A clump is relatively isolated from other clumps or trees within a group of trees, but a standalone clump of trees can function as a tree group.

Coarse woody debris is woody material on the ground greater than 3 inches in diameter, including logs.

Collaboration describes people working together to share knowledge and resources to describe and achieve desired conditions for National Forest System (NFS) lands and for associated social, ecological, and economic systems in a plan area. Collaboration applies throughout land management, encompasses a wide range of external and internal relationships, and entails formal and informal processes.

Connectivity is the ecological conditions that exist at several spatial and temporal scales that provide landscape linkages that permit the exchange of flow, sediments, and nutrients; the daily

and seasonal movements of animals within home ranges; the dispersal and genetic interchange between populations; and the long distance range shifts of species, such as in response to climate change.

Corporate Databases are Forest Service-wide information management systems using a common information structure and process to store, maintain and access shared automated inventory, monitoring, and assessment data.

Declining refers to the senescent (aging) period in the lifespan of plants that (for trees) includes the presence of large dead and/or dying limbs, snag tops, large, old lightning scars, and other characteristics that indicate the later life stages of vegetation.

Desired Conditions are the ecological and socioeconomic attributes toward which management of the land and resources of the plan area are directed. They are not commitments or final decisions approving projects or activities; rather, they guide the development of projects and activities.

Designated Areas are areas or features identified and managed to maintain their unique special character or purpose. Some categories of designated areas may be designated only by statute and some categories may be established administratively in the land management planning process or by other administrative processes of the Federal executive branch. Examples of statutorily designated areas are national heritage areas, national recreation areas, national scenic trails, wild and scenic rivers, wilderness areas, and wilderness study areas. Examples of administratively designated areas are experimental forests, research natural areas, scenic byways, botanical areas, and significant caves.

Diameter at breast height (d.b.h.) is the diameter of a tree typically measured at 4.5 feet above ground level.

Diameter at root collar (d.r.c.) is the diameter typically measured at the root collar or at the natural ground line, whichever is higher, outside the bark. For a multi-stemmed tree, d.r.c. is calculated from the diameter measurements of all qualifying stems (1.5 inches or greater diameter and at least 1 foot in length).

Dispersed recreation is outdoor recreation in which visitors are spread over relatively large areas. Where facilities or developments are provided, they are more for access and protection of the environment than for the comfort or convenience of the visitors.

Disturbance is any relatively discrete event in time that disrupts ecosystem, watershed, community, or species population structure and/or function and changes resources, substrate availability, or the physical environment.

Disturbance regime is a description of the characteristic types of disturbance on a given landscape; the frequency, severity, and size distribution of these characteristic disturbance types; and their interactions.

Diversity is the distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.

Drinkers are devices that provide water for livestock or wildlife in a contained, aboveground location.

Endemic describes a population that has unique genetic characteristics and likely exists in a very limited geographic area.

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

Even-aged stand is a stand of trees composed of a single age class.

Even-aged silvicultural practices are the application of a combination of actions that results in the creation of stands in which trees of essentially the same age grow together. Managed even-aged forests are characterized by a distribution of stands of varying ages (and, therefore, tree sizes) throughout the forest area. The difference in age between trees forming the main canopy level of a stand usually does not exceed 20 percent of the age of the stand at harvest rotation age. Regeneration in a particular stand is obtained during a short period at or near the time that a stand has reached the desired age or size for regeneration and is harvested. Clearcut, shelterwood, or seed tree cutting methods produce even-aged stands.

Federally recognized Indian Tribe is an Indian or Alaska Native Tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges to exist as an Indian Tribe under the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. 479a.

Fire regime refers to the patterns of fire that occur over a long period of time across an appropriately scaled area and its immediate effects on the ecosystem in which it occurs. Five fire regimes are classified based on frequency (average number of years between fires) and severity (amount of replacement on the dominant overstory vegetation) of the fire. These five regimes are:

> **Fire Regime I**: 0 to 35-year frequency and low (surface fires most common, isolated torching can occur) to mixed severity (less than 75 percent of dominant overstory vegetation replaced).
>
> **Fire Regime II**: 0 to 35-year frequency and high severity (greater than 75 percent of dominant overstory vegetation replaced).
>
> **Fire Regime III**: 35 to 100+-year frequency and mixed severity.
>
> **Fire Regime IV**: 35 to 100+-year frequency and high severity.
>
> **Fire Regime V**: 200+-year frequency and high severity.

Fire suppression is the work of extinguishing a fire or confining fire spread.

Forage is: (1) browse and herbage which is available and can provide food for animals or be harvested for feeding; or (2) to search for or consume forage. ITR 1734-4.

Forested land is land at least 10 percent occupied by forest trees of any size or formerly having had such tree cover and not currently developed for nonforest use. Lands developed for nonforest use include areas for crops, improved pasture, residential, or administrative areas, improved roads of any width, and adjoining road clearing and powerline clearing of any width.

Functioning ecosystem is an ecosystem that contains all components and processes necessary to maintain resilience over time.

Gap refers to the space occurring in a forested area as a result of individual or group tree mortality from small disturbance events or from local site factors such as soil properties that influence vegetation growth patterns.

Goals are concise statements that describe desired conditions to be achieved sometime in the future. They are normally expressed in broad, general terms and are timeless in that they have no specific date by which they are to be completed. Goal statements form the principal basis from which desired conditions and objectives are developed.

Goods and services are the various outputs—including onsite uses—produced from forest and rangeland resources.

Goshawk post-fledging family areas (PFAs) are the areas that surround nest areas. They represent an area of concentrated use by the northern goshawk family until the young are no longer dependent on adults for food. PFAs are approximately 420 acres in size (not including the nest area acres).

Group refers to a cluster of two or more trees with interlocking or nearly interlocking crowns at maturity surrounded by an opening. Size of tree groups is typically variable depending on forest type and site conditions, and can range from fractions of an acre (a 2-tree group) to many acres. Trees within groups are typically not uniformly spaced and some may be tightly clumped.

Guidelines are technical design criteria or constraints on project and activity decision making that help to make progress toward desired conditions. A guideline allows for departure from its terms, so long as the intent of the guideline is met. Deviation from a guideline must be specified in the decision document with the supporting rationale. When deviation from a guideline does not meet the original intent, a plan amendment is required.

Hydrologic function is behavioral characteristics of a watershed described in terms of ability to sustain favorable conditions of waterflow. Favorable conditions of waterflow are defined in terms of water quality, quantity, and timing.

Hydrologic unit code refers to the division and subdivision of the United States into successively smaller hydrologic units, which are identified by unique hydrologic unit codes (HUCs). The number of digits in a HUC indicates its relative size; HUCs with more digits are smaller than HUCs with fewer digits.

Hydrophytes are plants that grow only in water or very moist soil.

Initial attack/initial action are actions taken by the first firefighting resources to arrive at a wildfire.

Integration recognizes and identifies key relationships between various plan resources and activities. Plan components are integrated to address a variety of ecological and human needs. For example, desired conditions for ponderosa pine incorporate habitat needs for a variety of species, as well as the scenic components recreationists desire. Interrelationships between parts of the plan are identified with crosswalks to show their systematic nature.

Interspaces are the open spaces not under the vertical projection of the outermost perimeter of tree canopies. They are generally composed of grass-forb-shrub vegetation but may also include scattered rock or bare soil. Interspaces do not include meadows, grasslands, rock outcroppings and wetlands.

Invasive species are species that are not native to the ecosystem being described. For all ecosystems, the desired condition is that invasive species are rarely present, or are present at levels that do not negatively influence ecosystem function.

Inventory is the survey of an area or entity for determination of such data as contents, condition, or value, for specific purposes such as planning, evaluation, or management. An inventory activity may include an information needs assessment; planning and scheduling; data collection, classification, mapping, data entry, storage and maintenance; product development; evaluation; and reporting phases.

Key ecological attributes are attributes for which alteration beyond some critical range/threshold will lead to loss of the resource in a short period of time. Examples include changes in structure, composition, pattern, and process.

Litter is dead, unattached organic material on the soil surface that is effective in protecting the soil surface from raindrop splash, sheet, and rill erosion and is at least ½-inch thick. Litter is composed of leaves, needles, cones, and woody vegetative debris, including twigs, branches, and trunks.

Long-term, sustained-yield timber capacity is the highest uniform wood yield from lands being managed for timber production that may be sustained under a specified management intensity consistent with multiple-use objectives.

Maintain, in reference to an ecological condition, is to keep in existence or continuance of the desired ecological condition in terms of its desired composition, structure, and processes. Depending upon the circumstance, ecological conditions may be maintained by active or passive management or both.

Management area is a land area identified within the planning area that has the same set of applicable plan components. A management area does not have to be spatially contiguous.

Management concern is an issue, problem, or condition that constrains the range of management practices identified by the Forest Service in the planning process.

Management direction is a statement of multiple use and other goals and objectives, the associated management prescriptions, and standards and guidelines for attaining them.

Management intensity is the management practice or combination of management practices and associated costs designed to obtain different levels of goods and services.

Management practice is a specific activity, measure, course of action, or treatment.

Management prescription refers to the management practices and intensity selected and scheduled for application on a specific area to attain multiple use and other goals and objectives.

Monitoring is the collection and analysis of repeated observations or measurements to evaluate changes in condition and progress toward meeting a resource or management objective. A monitoring activity may include an information needs assessment; planning and scheduling; data collection, classification, mapping, data entry, storage and maintenance; product development; evaluation; and reporting phases.

Mosaic is described as the patterns of patches, corridors, and matrix (forest or non-forest) that form a landscape in its entirety.

Multiple use is the management of all the various renewable surface resources of NFS lands so they are utilized in the combination that will best meet the needs of the American people. This includes making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions. Some lands will be used for less than all of the resources. Multiple use includes the harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output.

Native species is an organism that was historically or is currently present in a particular ecosystem as a result of natural migratory or evolutionary processes and not as a result of an accidental or deliberate introduction into that ecosystem. An organism's presence and evolution (adaptation) in an area are determined by climate, soil, and other biotic and abiotic factors.

Natural variability references past conditions and processes that provide important context and guidance relevant to the environments and habitats in which **native species** evolved. Disturbance driven spatial and temporal variability is vital to ecological systems. Biologically appropriate disturbances provide for heterogeneous conditions and subsequent diversity, whereas "uncharacteristic disturbance" such as high-intensity fire can have the effect of reducing diversity, increasing homogeneity, and resulting in states that may be permanently altered.

Natural waters are features such as springs, seeps, ponds, lakes and streams that are not human-created. Natural waters may or may not have experienced human modification.

Nest areas (goshawk) are the areas immediately around a nest that are used by northern goshawks in relation to courtship and breeding activities. They cover approximately 30 acres and contain multiple groups of large, old trees with interlocking crowns.

Noxious weed is a legal term applied to plants or plant parts regulated by Federal and State laws. Arizona Administrative Codes R3-4-244, R3-4-245 (Arizona Department of Agriculture 1999) regulate certain invasive species in the state: "A noxious weed is defined as any species of plant that is detrimental or destructive and difficult to control or eradicate and includes plant organisms found injurious to any domesticated, cultivated, native, or wild plant." The director of Arizona's noxious weed program uses five biological criteria to describe noxious weeds: (1) exotic, (2) invasive, (3) competitive, (4) persistent, and (5) aggressive.

Nurse trees are larger trees that shelter young trees. Nurse trees create an understory microclimate with improved nutrient and soil properties, higher soil moisture, lower temperatures, and lower light levels, all of which facilitate the growth of the smaller tree.

Nutrient cycling is the circulation and exchange of elements such as nitrogen and carbon between nonliving and living portions of the environment.

Objectives are concise, time specific statements of measurable planned results that respond to pre-established goals. Objectives form the basis for further planning to define the precise steps to be taken and the resources to be used in achieving identified goals.

Old growth in southwestern forested ecosystems is different than the traditional definition based on northwestern infrequent fire forests. Due to large differences among Southwest forest types and natural disturbances, old growth forests vary extensively in tree size, age classes, presence and abundance of structural elements, stability, and presence of understory (Helms 1998). Old growth refers to specific habitat components that occur in forests and woodlands—old trees, dead trees (snags), downed wood (coarse woody debris), and structure diversity (Franklin and Spies 1989, Helms 1998, Kaufmann et al. 2007). These important habitat features may occur in small areas, with only a few components, or over larger areas as stands or forests where old growth is concentrated (Kaufmann et al. 2007). In the Southwest, old growth is considered "transitional" (Oliver and Larson 1996), given that the location of old growth shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality). Some species, notably certain plants, require "old forest" communities that may or may not have old growth components but have escaped significant disturbance for lengths of time necessary to provide the suitable stability and environment.

Openings are spatial breaks between groups or patches of trees as large as or larger than groups that contain grass, forb, shrub, and/or tree seedlings, but are largely devoid of big trees with a total tree cover of less than 10 percent.

Patches are areas larger than tree groups in which the vegetation composition and structure are relatively homogeneous. Patches comprise the midscale, thus they range in size from 100 to 1,000 acres.

Plan or land and resource management plan refers to a document or set of documents that provide management direction for an administrative unit of the NFS developed under the requirements of a planning rule.

Planning area is the area of the NFS covered by a plan.

Planning period is the time interval within the planning horizon (the overall time period considered in the planning process that spans all activities covered in the analysis or plan and all future conditions and effects of proposed actions which would influence planning decisions) that is used to show incremental changes in yields, costs, effects, and benefits (one decade).

Post-fledging family areas (goshawk) surround the nest areas. They represent an area of concentrated use by the goshawk family until the time the young are no longer dependent on adults for food. PFAs are approximately 420 acres in size.

Potential natural vegetation types are the "climax" vegetation that will occupy a site without disturbance or climatic change. PNV is an expression of environmental factors such as topography, soils, and climate across an area.

Predator-prey relationship is a natural relationship which helps to maintain healthy wildlife populations. Top level predators hunt sick, weak, and/or young prey; this in turn keeps growth and carrying capacity of hunted species in balance with their surrounding environment. Examples include carnivores such as mountain lions and wolves, which prey on deer or elk, or raptors which regulate small mammal populations.

Prescribed fire is a wildland fire originating from a planned ignition to meet specific objectives identified in a written, approved, prescribed fire plan for which NEPA requirements have been met prior to ignition.

Project refers to an organized effort to achieve an outcome on NFS lands identified by location, tasks, outputs, effects, times, and responsibilities for execution.

Range readiness is the condition when grazing would not permanently damage perennial plants. Range readiness is determined when plants that would likely be grazed exhibit at least one of the following characteristics: seed heads or flowers, multiple leaves or branches, and/or a root system that does not allow them to be easily pulled from the ground. These characteristics provide evidence of plant vigor, reproductive ability, and recovery.

Ranges of Values presented in desired conditions account for natural or desired variation in the composition and structure within a community or resource area. Desired conditions may have a wide range due to spatial variability in soils, elevation, aspect, or social values. Where desired conditions specify a range, the full spectrum of values within that range is desirable, although the desired distribution may vary depending on the resource. It may also be desirable to manage for desired conditions at the upper or lower end of a range in a particular area, such as lower vegetation density in the wildland-urban interface (WUI) to achieve the desired fire behavior within proximity of private property and human occupancy; higher densities may be desired in other areas to meet habitat requirements for specific species.

Recreation opportunity spectrum is the framework for defining the types of outdoor recreation opportunities the public might desire, and identifying that portion of the spectrum a given national forest area might be able to provide. The broad classes are:

> **Primitive (P)**, which is characterized by an essentially unmodified natural environment. Interaction between users is very low and evidence of other users is minimal. Essentially free from evidence of human-induced restrictions and controls. Motorized use within the area is generally not permitted. Very high probability of experiencing solitude, closeness to nature, tranquility, self-reliance, and risk.
>
> **Semiprimitive Nonmotorized (SPNM)**, which is characterized by a predominantly natural or natural appearing environment. Interaction between users is low, but there is often evidence of other users. The area is managed in such a way that minimum onsite controls and restrictions may be present, but are subtle. Motorized use is generally not permitted. High probability of experiencing solitude, closeness to nature, tranquility, self-reliance, and risk.
>
> **Semiprimitive Motorized (SPM)**, which is characterized by a predominantly natural or natural appearing environment. Concentration of users is low, but there

is often evidence of other users. The area is managed in such a way that minimum onsite controls and restrictions may be present, but they are subtle. Motorized use is generally permitted. Moderate probability of experiencing solitude, closeness to nature, tranquility, self-reliance, and risk.

Roaded Natural (RN), which is characterized by a predominantly natural appearing environment with moderate evidence of the sights and sounds of other humans. Such evidence usually harmonizes with the natural environment. Interaction between users may be low to moderate, but with evidence of other users prevalent. Resource modification and utilization practices are evident, but harmonize with the natural environment. Conventional motorized use is provided for in construction standards and design of facilities. Opportunity to affiliate with other users in developed sites, but with some chance for privacy.

Roaded Modified (RM), which is characterized by substantially modified natural environment except for campsites. Roads and management activities may be strongly dominant. There is moderate evidence of other users on roads. Conventional motorized use is provided for in construction standards and design of facilities. Opportunity to get away from others, but with easy access.

Rural (R), which is characterized by substantially modified natural environment. Resource modification and utilization practices are to enhance specific recreation activities and to maintain vegetative cover and soil. Sights and sounds of humans are readily evident, and the interaction between users is often moderate to high. A considerable number of facilities are designed for use by a large number of people. Facilities are often provided for special activities. Moderate densities are provided far away from developed sites. Facilities for intensified motorized use and parking are available. Opportunity to observe and affiliate with other users is important, as is convenience of facilities.

Urban (U), which is characterized by a substantially urbanized environment, although the background may have natural appearing elements. Resource modification and utilization practices are to enhance specific recreation activities. Vegetative cover is often exotic and manicured. Sights and sounds of humans onsite are predominant. Large numbers of users can be expected, both onsite and in nearby areas. Facilities for highly intensified motor use and parking are available with forms of mass transit often available to carry people throughout the site. Opportunity to observe and affiliate with other users is very important, as is convenience of facilities.

Recreation setting refers to the social, managerial, and physical attributes of a place that, when combined, provide a distinct set of recreation opportunities. The Forest Service uses the recreation opportunity spectrum to define recreation settings and categorize them into six distinct classes: primitive, semiprimitive nonmotorized, semiprimitive motorized, roaded natural, rural, and urban.

Reference conditions are environmental conditions that infer ecological sustainability. When available, reference conditions are represented by the *characteristic* range of variation (not the total range of variation) prior to European settlement and under the current climatic period. For

many ecosystems, the range of variation also reflects human-caused disturbance and effects prior to settlement. It may also be necessary to refine reference conditions according to contemporary factors (e.g., invasive species) or projected conditions (e.g., climate change). Reference conditions are most useful as an inference of sustainability when they have been quantified by amount, condition, spatial distribution, and temporal variation.

Regeneration openings are opening created in the forest canopy to stimulate regeneration of a new age group of trees.

Research natural areas are specially designated areas that represent some of the finest examples of natural ecosystems for the purposes of scientific study, education, and for maintenance of biological diversity.

Resilience is the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change.

Responsible official is the Forest Service employee who has the authority to select and/or carry out a specific planning action.

Restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on establishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystem sustainability, resilience, and health under current and future conditions.

Risk is a combination of the likelihood that a negative outcome will occur and the severity of the subsequent negative consequences.

Scale. Desired conditions are described at multiple scales where appropriate. Descriptions at various scales are sometimes necessary to provide adequate detail and guidance for the design of future projects and activities that will help achieve the desired conditions over time. The three scales used in this plan are: fine scale, mid-scale, and landscape scale.

> **Fine scale** is an area10 acres or less in size at which the distribution of individual trees (single, grouped, or aggregates of **groups**) is described. Fine-scale desired conditions provide the view that can be observed standing in one location on the ground. Fine-scale desired conditions typically contain greater variability, which is desirable for providing heterogeneity at smaller spatial scales.
>
> **Mid-scale** desired conditions are composed of assemblages of fine-scale units and have descriptions that would be averaged across areas of 100- to 1,000-acre units.
>
> **Landscape scale** is an assemblage of 10 or more mid-scale units, typically totaling more than 10,000 acres, composed of variable elevations, slopes, aspects, soils, plant associations, and disturbance processes. Landscape scale desired conditions provide the big picture overview with resolution that would, for example, be observable from an airplane or from a zoomed out Google Earth view. The landscape scale is also appropriate scale for describing less common components that would not necessarily occur on every mid-scale unit within the landscape.

Scenic integrity objectives in the context of the plan are equivalent to goals or desired conditions. Scenic integrity describes the state of naturalness or a measure of the degree to which a landscape is visually perceived to be "complete." The highest scenic integrity ratings are given to those landscapes that have little or no deviation from the landscape character valued by constituents for its aesthetic quality. Scenic integrity is the state of naturalness or, conversely, the state of disturbance created by human activities or alteration. Scenic integrity is measured in five levels:

> **Very high** (unaltered): A scenic integrity level that generally provides for ecological change only.
>
> **High** (appears unaltered): Human activities are not visually evident. In high scenic integrity areas, activities may only repeat attributes of form, line, color, and texture found in the existing landscape character.
>
> **Moderate** (slightly altered): Landscapes where the valued landscape character "appears slightly altered." Noticeable deviations must remain visually subordinate to the landscape character being viewed.
>
> **Low** (moderately altered): Human activities must remain visually subordinate to the attributes of the existing landscape character. Activities may repeat form, line, color, or texture common to these landscape characters, but changes in quality of size, number, intensity, direction, pattern, and so on, must remain visually subordinate to these landscape characters.
>
> **Very low** (heavily altered): Human activities of vegetative and landform alterations may dominate the original, natural landscape character, but should appear as natural occurrences when viewed at background distances.

Snags are standing dead or partially dead trees (snag topped), often missing many or all limbs. They provide essential wildlife habitat for many species and are important for forest ecosystem function.

Stand density index (SDI) is a relative measure of stand density the converts a stand's current density into a density at a reference size (Reineke 1933).

Standards are technical design constraints that must be followed when an action is being taken to make progress toward desired conditions. Standards differ from guidelines in that standards do not allow for any deviation without a plan amendment.

Strongly interactive species is a species whose absence leads to significant changes in some feature of its ecosystem(s). Such changes include structural or compositional modifications, alterations in the import or export of nutrients, loss of resilience to disturbance, and decreases in native species diversity. The type of interactions these species have with their surrounding environment is paramount to the persistence of certain ecosystem features through time. Examples of strong interactions include mutualisms (e.g., pollinators such as butterflies, and spore and seed dispersers such as birds), consumers (e.g., large predators such as mountain lions), and ecosystem engineers (e.g., prairie dogs, beavers).

Suitability is the appropriateness of applying certain resource management practices to a particular area of land, as determined by an analysis of the economic and environmental consequences and the alternative uses foregone. A unit of land may be suitable for a variety of individual or combined management practices.

Sustainability is the capability to meet the needs of the present generation without compromising the ability of future generations to meet their needs. For purposes of this plan, "ecological sustainability" refers to the capability of ecosystems to maintain ecological integrity; "economic sustainability" refers to the capability of society to produce and consume or otherwise benefit from goods and services including contributions to jobs and market and nonmarket benefits; and "social sustainability" refers to the capability of society to support the network of relationships, traditions, culture, and activities that connect people to the land and to one another, and support vibrant communities.

Thinning Methods

> **Single tree selection** is used in uneven-aged silvicultural systems in which scattered individual trees of multiple size and/or age classes are removed throughout the stand to achieve desired structural characteristics.
>
> **Group selection** is a method of regenerating uneven-aged stands in which trees are removed, and new age classes are established, in small groups. Small openings provide micro-environments suitable for tolerant regeneration and the larger openings provide conditions suitable for more intolerant regeneration. In the group selection system, the management unit or stand in which regeneration, growth, and yield are regulated consists of a landscape containing an aggregation of groups
>
> **Sanitation cutting** is the removal of dead, dying, or damaged trees to prevent or interrupt the spread of insects or disease.
>
> **Salvage cutting** is the removal of trees that have been killed or damaged by wildland fire, severe wind, insects or disease, or other natural disturbances.
>
> **Even-aged regeneration** is a cutting method by which a new stand with a single age class is created.
>
> **Matrix thinning** is the thinning of the "matrix" of trees outside of a regeneration area. The matrix is generally thinned from below to some specified density in order to increase stand vigor and resiliency.
>
> **All-size free thinning** is the removal of trees to control stand spacing and favor desired trees, using a combination of thinning criteria without regard to crown position.
>
> **Thinning from below** is the removal of trees from lower canopy positions while retaining the largest and most vigorous trees with the best-developed crowns.

Timber production is the purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use. For purposes of this plan, the term timber production does not include production of firewood.

Traditional cultural property refers to a type of historic property defined as "eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community."

Uneven-aged forests are forests that are composed of three or more distinct age classes of trees, either intimately mixed or in small groups.

Uneven-aged management is the application of a combination of actions needed to simultaneously maintain continuous high forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes to provide a sustained yield of forest products. Cutting is usually regulated by specifying the number or proportion of trees of particular sizes to retain within each area, thereby maintaining a planned distribution of size classes. Cutting methods that develop and maintain uneven-aged stands are single tree selection and group selection.

Utility Corridor is a linear strip of land identified for the present or future location of transportation or utility rights-of-way within its boundaries.

Vegetation Structure includes both the vertical and horizontal dimensions. Horizontal structure may refer to patterns of trees or groups of trees and openings, as well as tree size and tree density. Vertical structure may refer to the layers, appearance, and composition of vegetation between the forest floor and the top of the canopy.

Viable population is a population of a species that continues to persist over the long term with sufficient distribution to be resilient and adaptable to stressors and likely future environments.

Watershed is a region or land area drained by a single stream, river, or drainage network; a drainage basin.

Watershed condition is the state of a watershed based on physical and biogeochemical characteristics and processes.

Wetlands are areas inundated by surface water or groundwater with a frequency sufficient to support, and under normal circumstances, a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil condition for growth and reproduction. Generally includes swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds.

Wide ranging species are **s**pecies that have large area requirements, utilizing expansive landscapes for breeding, foraging, and movement that are typically beyond the boundaries of any one land management jurisdiction. Examples include large birds of prey, migratory birds, and nomadic mammals subject to seasonal movements (e.g., winter and summer range for deer, elk, and pronghorn).

Wilderness describes any area of land designated by Congress as part of the National Wilderness Preservation System that was established in the Wilderness Act of 1964 (16 U.S.C. 1131-1136).

Wildfire is an unplanned ignition of a wildland fire, such as fire caused by lightning, unauthorized or accidental human-caused fires, or an escaped prescribed fire.

Wildland fire is a general term describing any nonstructure fire that occurs in the wildland. This includes both prescribed fires and wildfires.

Wildlife Corridors are land that connects two or more areas of habitat through which a species can travel or reach areas suitable for reproduction or other life-sustaining needs.

Wildland-urban interface (WUI) describes a line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetation fuels.

Witches' broom is a disease or deformity in a woody plant (typically a tree) that results in a dense mass of shoots resembling a broom or bird's nest.

Essential Government Acronym Dictionary (EGAD)

Acronym	Term
4FRI	Four Forest Restoration Initiative
ADEQ	Arizona Department of Environmental Quality
ADOT	Arizona Department of Transportation
AMS	analysis of the management system
AOI	annual operating instructions
ASQ	allowable sale quantity
AGFD	Arizona Game and Fish Department
BA	basal area
BLM	Bureau of Land Management
BMP	best management practice
CCF	hundred cubic feet
CER	comprehensive evaluation report
CPST	Climate Project Screening Tool
CWPP	community wildfire protection plan
d.b.h.	diameter at breast height
DC	desired conditions
EIS	environmental impact statement
d.r.c.	diameter at root collar
ENSO	El Niño Southern Oscillation
EPA	Environmental Protection Agency
FACTS	Forest Service Activity Tracking System
FIA	Forest Inventory Assessment
FSH	Forest Service Handbook
FSM	Forest Service Manual
GIS	geographic information system
HFRA	Healthy Forest Restoration Act
HUC	hydrologic unit code
IPM	integrated pest management
KFHF	Kaibab Forest Health Focus
LAC	limits of acceptable change

LTSY	long term sustained yield
MA	management area
MIS	management indicator species
MOU	memorandum of understanding
MSO	Mexican spotted owl
MVUM	motor vehicle use map
NAAQS	National Ambient Air Quality Standards
NAU	Northern Arizona University
NEPA	National Environmental Policy Act
NF	national forest
NFMA	National Forest Management Act
NFS	National Forest System
NKRD	North Kaibab Ranger District
NNL	National Natural Landmark
NPS	National Park Service
NRIS	Natural Resource Information System
NRM	Natural Resource Manager
OHV	off-highway vehicle
PAC	protected activity center
PFC	proper functioning condition
PIT	Passport in Time
PJ	pinyon-juniper
PNVT	potential natural vegetation type
PWA	potential wilderness area
RD	ranger district
RNA	Research Natural Area
ROD	record of decision
ROS	recreation opportunity spectrum
SAVS	system for assessing vulnerability of species
SDI	stand density index
SIO	scenic integrity objectives
SWAP	State Wildlife Action Plan
TCP	traditional cultural property

TES	terrestrial ecosystem survey; threatened, endangered, and sensitive species
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
VDDT	Vegetation Development Dynamics Tool
WFDSS	Wildfire Fire Decision Support System
WNS	white nose syndrome
WUI	wildland-urban interface

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Appendix A. Proposed and Possible Actions

This appendix describes the proposed and possible actions that may occur within the plan area during the life of the plan (approximately 10 to 15 years), including the methods of forest vegetation management practices expected to be used (16 U.S.C. 1604(e)(2) and (f)(2)). This list of proposed and possible actions is not intended to be all-inclusive; it is simply a list of possible actions that may take place. The actions described in this Appendix do not commit the Agency to perform work; instead, they are provided as possible actions that would likely be consistent with plan components, particularly the desired conditions and objectives. Furthermore, this information is not a "proposal" as defined by the Council on Environmental Quality regulations for implementing NEPA (40 CFR 1508.23, 42 U.S.C. 4322(2)(C)).

A plan amendment is not required to change or modify any of the proposed or possible actions. The list of these actions can be updated at any time through an administrative correction of the plan.

Vegetation Management

Mechanically thin at least 11,000 to 19,000 acres in ponderosa pine and another 1,200 to 2,100 acres annually in the frequent fire mixed conifer type forestwide (mechanical treatment acreage may be greater to support landscape-scale restoration projects, needs, or opportunities). Thinning treatments would use a combination of prescriptions to meet desired conditions including free thinning all sizes to a target basal area, group selection cuts with matrix thinning to a target basal area, individual tree selection, thin from below, sanitation, and regeneration cuts.

The allowable sale quantity (ASQ) is 107,815 CCF (hundred cubic feet) per year. The ASQ is better described as the "average allowable sale quantity" because it may be exceeded in a given year as long as the 10-year average is not exceeded.

Other vegetation management activities expected to occur include:

- Reducing tree density in pinyon-juniper woodlands
- Planting trees on 300 to 700 acres annually in areas where seed source has been lost
- Reducing conifer encroachment on 800 acres of aspen and fencing 200 acres of aspen within 10 years of plan approval
- Restoring grasslands by reducing tree density to less than 10 percent on 5,000 to 10,000 acres of historic grasslands annually

Fire and Fuels Management

- Use prescribed fire and wildfire on 14,000 to 68,000 acres per year (in all vegetation types except desert communities) to reduce fuel loadings, restore forest structure, promote understory vegetation, improve nutrient cycling, etc.
- Suppress human-caused wildfires.
- Burn activity generated slash.
- Thin and treat fuels in the wildland-urban interface and around other highly valued human improvements to prevent loss in the event of a wildfire, and thin to improve control lines for prescribed burns.

Water Resources

- Restore and protect at least 10 individual springs through fencing, maintenance, revegetation, and establishing trails and points of entry.
- Fence wetlands for resource protection.
- Restore native vegetation and natural waterflow patterns on at least 6 acres of wetlands within 5 years of plan approval
- Monitor water quality of lakes.

Wildlife and Plants

- Improve pronghorn population connectivity by removing or modifying 50 miles of fence within 10 years of plan approval.
- Inventory and monitor Mexican spotted owls, bald and golden eagles, peregrine falcons, northern goshawks, Gunnison's prairie dogs, and other wildlife species of conservation concern.
- Conduct floristic surveys.
- Collaborate with other Federal and State biologists and researchers to address a variety of wildlife issues.
- Inspect, maintain, and construct fenced exclosures around wetlands that are important to wildlife.
- Monitor populations of invasive species that occur on the Kaibab NF.
- Treat weeds using an integrated pest management approach, which includes chemical, biological, and physical methods, on 2,000 to 3,000 acres annually.

Recreation

- Maintain trails according to development level and managed use.
- Provide interpretive programs for school groups and other activities that connect youth, low-income, and minority populations with nature.
- Education and outreach programs and/or improved signage to help reduce user conflicts.
- Conduct long-range planning for trails, wilderness, and outfitter/guide permits. These efforts could result in the development or improvement of trails and trail spurs to accommodate user needs and in increased authorized outfitter/guide use.
- Develop a Sustainable Recreation Management Plan, which will provide a framework for developing and/or decommissioning recreation sites as needed to meet public need.
- Develop a Visitor Guide and other literature to improve public education and outreach.
- Regularly update Recreation Opportunity Guides to ensure accuracy of information and improve electronic delivery/availability of this information.
- Implementation of the Corridor Management Plan for the Kaibab Plateau-North Rim Scenic Byway.
- Review and correct alignment of the Arizona Trail. Develop or improve trailheads, spurs, and signing where needed.

Livestock Grazing

- Grazing of cattle, sheep, and horses consistent with other desired conditions.
- Monitoring and adapt grazing management.

Forestry and Forest Products

- Offer wood products for sale.
- Provide opportunities for commercial and personal firewood collection.
- Sell Christmas tree permits.
- Provide forest products for traditional cultural uses.

Heritage Resources

- Conduct project- and non-project-related cultural resources surveys.
- Host “Passport In Time” and other cultural resource events and projects.
- Provide at least 20 interpretive programs per year.
- Monitor 18 Priority Heritage Asset Sites per year.

Roads and Access

- Grade roads and clean culverts on 100 miles of open National Forest System roads annually.
- Maintain ownership boundaries.
- Acquire legal access, as opportunities arise.
- Decommission roads that are no longer needed.
- Obliterate or naturalize 20 miles of nonsystem roads (unauthorized, decommissioned, etc.) within 10 years of plan approval.
- Implement decisions made under the 2005 Travel Management Rule.

Land Adjustments

- Land adjustments where feasible and advantageous to the Kaibab NF.

Minerals and Energy Uses

- Uranium mining on claims with valid existing rights.
- Sandstone quarrying.
- Rehabilitation of common variety mineral sites no longer in use.

Special Uses

- Construction and maintenance of communication and electronic sites.
- Review of new proposals for various uses. Environmental analysis of approved proposals and issuance of new permits.
- Authorization and/or reauthorization of recreation special use permits, such as outfitter/guides, recreation events, and resorts.

- Conduct long-range planning for outfitter/guide and recreation event permits. This effort could result in increased permit issuance and improvement of trails or other sites for these uses.

Special Areas

- Implement the comprehensive plan for the Arizona National Scenic Trail including trail maintenance and signing.
- Capture and relocate wild burros.
- Monitor Arizona Bugbane and Pediocactus populations.

Wilderness

- Development and implementation of wilderness management plans.
- Implementation of wilderness education plans.
- Continued partnership with Northern Arizona University wilderness course to improve wilderness management.
- Ongoing monitoring of wilderness character and solitude in accordance with national protocols.
- Ongoing inventory and monitoring of camp sites in accordance with national protocols.
- Continued invasive plant surveys and monitoring, and eradication when necessary.
- Monitoring tamarisk beetle activity in Kanab Creek Wilderness.
- Implementation of the Wilderness Information Needs Assessment, which includes various methods of survey and data gathering to inform management of existing conditions and to inform potential management actions to preserve wilderness character.

Monitoring, Adaptive Management, and Capacity Building

- Monitor and report on indicators as described in the Monitoring and Evaluation Implementation Guide to assess existing conditions, track accomplishments, and determine treatment effectiveness.
- In response to monitoring findings, reevaluate and adapt management approaches and treatment strategies where necessary to more effectively achieve desired conditions.
- Establish and maintain mutually beneficial partnerships with tribes, community groups, governmental and nongovernmental organizations, and academic institutions.
- Issue permits for research occurring on the Kaibab NF.

Appendix B. Relevant Laws, Regulation, and Policy

The operating environment for managing NFS lands comes from a variety of sources. This appendix contains a partial listing of relevant statutes, regulations, policies, and agreements. Kaibab NF projects and activities are developed to be consistent with the direction found in the plan, as well as applicable laws, regulations, and executive orders. Other relevant sources that provide varying levels of guidance include Forest Service Handbooks and Manuals, programmatic agreements, memoranda of understanding, memoranda of agreement, and existing decisions.

Federal Statutes

The following is a partial listing of relevant laws which have been enacted by Congress. A Federal statute, or law, is an act or bill which has become part of the legal code through passage by Congress and approval by the President (or via congressional override). Although not specified below, many of these laws have been amended.

American Indian Religious Freedom Act (AIRFA) as amended (42 U.S.C. 1996)

Protects and preserves for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions of the American Indian, Eskimo, Aleut, and Native Hawaiians, including but not limited to access to sites, use, and possession of sacred objects and the freedom to worship through ceremonial and traditional rites.

Americans with Disabilities Act of 1990

Provides a clear and comprehensive national mandate for the elimination of discrimination against individuals with disabilities; for clear, strong, consistent, and enforceable standards addressing discrimination against individuals with disabilities; to ensure that the Federal Government plays a central role in enforcing the standards established in this act on behalf of individuals with disabilities; and to invoke the sweep of congressional authority, including the power to enforce the fourteenth amendment and to regulate commerce, in order to address the major areas of discrimination faced by people with disabilities.

Antiquities Act of 1906 (16 U.S.C. 431-433)

Prevents the appropriation, excavation, injury, or destruction of any historic or prehistoric ruin or monument, or any object of antiquity, situated on lands owned or controlled by the United States, without permission. Provides for permits, for misdemeanor-level penalties for unauthorized use, and authorizes the President to declare by public proclamation historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest that are situated upon lands owned or controlled by the United States to be national monuments, and to reserve as a part thereof parcels of land needed for the proper care and management of the objects to be protected. The Archaeological Resources Protection Act has replaced the Antiquities Act as the authority for special use permits if the resource involved is 100-years old or greater.

Archaeological and Historic Preservation Act of 1974 (AHPA) (16 U.S.C. 469)

This act is also known as the Archaeological Recovery Act. AHPA amended and expanded the Reservoir Salvage Act of 1960 and was enacted to complement the Historic Sites Act of 1935 by providing for the preservation of significant scientific, historical, and archaeological data which might be lost or destroyed as the result of the construction of a federally authorized dam or other construction activity. AHPA also allows for any Federal agency responsible for a construction project to appropriate a portion of project funds for archaeological survey, recovery, analysis, and publication of results.

Archaeological Resources Protection Act of 1979 as amended (ARPA) (16 U.S.C. 470 aa et seq.)

The act establishes permit requirements for removal or excavation of archaeological resources from Federal and Indian lands. Provides criminal and civil penalties for the unauthorized excavation, removal, damage, alteration, defacement, or the attempted unauthorized removal, damage, alteration, or defacement of any archaeological resource more than 100 years of age found on Federal or Indian lands. Prohibits the sale, purchase, exchange, transportation, receipt, or offering of any archaeological resource obtained from public lands or Indian lands. The act further directs Federal land managers to survey land under their control for archaeological resources and create public awareness programs concerning archaeological resources.

Bald and Golden Eagle Protection Act of 1940, as amended

The act prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald and golden eagles, including their parts, nests, or eggs. The act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." Disturbance includes impacts that result from human-induced alterations in the nesting area even when eagles are not present. Sections 22.26—28 allow take of bald and golden eagles or their nests where it is unavoidable and where it is compatible with the continued preservation of the eagle. Permits for take are issued based on certain criteria such as, but not limited to, certifications, reporting, and monitoring.

Clean Air Act of August 7, 1977, as amended (1977 and 1990) 42 U.S.C. §7401 et seq. (1970)

Enacted to protect and enhance the quality of the Nation's air resources; to initiate and accelerate a national research and development program to achieve the prevention and control of air pollution; to provide technical and financial assistance to state and local governments in connection with the development and execution of their air pollution prevention and control programs; and to encourage and assist the development and operation of regional air pollution prevention and control programs.

Clean Water Act (see Federal Water Pollution Control Act)

Common Varieties of Mineral Materials Act of July 31, 1947

Authorizes the Secretaries of the Interior and Agriculture, under such rules and regulations as they may prescribe, to dispose of mineral materials (including but not limited to common varieties of sand, stone, gravel, pumice, pumicite, cinders, and clay) and vegetative materials (including but not limited to yucca, manzanita, mesquite, cactus, and timber or other forest products) on public lands of the United States, if the disposal of such materials is not otherwise expressly authorized by law, is not expressly prohibited by laws of the United States, and would not be detrimental to the public interest.

Cooperative Forestry Assistance Act of July 1, 1978

Authorizes the Secretary of Agriculture to assist in the establishment of a coordinated and cooperative Federal, state, and local forest stewardship program for the management of non-Federal forest lands and forest lands in foreign countries.

Emergency Flood Prevention Act (Agricultural Credit Act) of August 4, 1978

Authorizes the Secretary of Agriculture to undertake emergency measures for runoff retardation and soil erosion prevention, in cooperation with landowners and users, as the Secretary deems necessary to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood, or other natural occurrence is causing or has caused a sudden impairment of that watershed.

Endangered Species Act of 1973, as amended

Authorizes the determination and listing of species as endangered and threatened; prohibits unauthorized taking, possession, sale, and transport of endangered species; authorizes the assessment of civil and criminal penalties for violating the act or regulations; and, authorizes the payment of rewards to anyone furnishing information leading to arrest and conviction for any violation of the act or any regulation issued thereunder. Section 7 of the act requires Federal agencies to use their authorities to carry out programs for the conservation of endangered and threatened species and to insure that any action authorized, funded, or carried out by them is not likely to jeopardize the continued existence of listed species or adversely modify their critical habitat.

Section 4 of the act directs the development and implementation of recovery plans for threatened and endangered species and the designation of critical habitat. Several species listed under the act are found on the Kaibab NF, some with recovery plans and some with designated critical habitat. Those with a recovery plan and/or a critical habitat designation are listed below:

> Recovery Plan for the Mexican spotted owl
> http://ecos.fws.gov/docs/recovery_plan/MSO_Recovery_Plan_First_Revision_Dec2012.pdf.

Critical Habitat for the Mexican spotted owl
http://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/MSO/FR_MSO_CH_8_31_04.pdf

Recovery Plan for the California condor
http://ecos.fws.gov/docs/recovery_plans/1996/960425.pdf

Critical Habitat for loach minnow and spikedace
http://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/SD_LM/2012_FR_SD-LM_fCHandUplisting.pdf

Energy Policy Act of 2005

Requires the Secretary of Agriculture to ensure timely action on oil and gas permits, improve collection and retrieval of oil and gas information, and improve inspection and enforcement of permit terms (Section 362).

Energy Security Act of June 30, 1980

Authorizes the Secretary of Agriculture to make available timber resources of the National Forest System, in accordance with appropriate timber appraisal and sale procedures, for use by biomass energy projects.

Federal Advisory Committee Act of October 6, 1972

Sets standards and uniform procedures to govern the establishment, operation, administration, and duration of advisory committees.

Federal Cave Resources Protection Act of November 18, 1988

Established requirements for the management and protection of caves and their resources on Federal lands, including allowing land managing agencies to withhold the location of caves from the public, and requiring permits for any removal or collecting activities in caves on Federal lands.

Federal Land Policy and Management Act of October 21, 1976

Requires that public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use. Also states that the United States shall receive fair market value of the use of the public lands and their resources unless otherwise provided for by law.

Federal Noxious Weed Act, 1974, as amended

Authorizes the Secretary of Agriculture to designate plants as noxious weeds by regulation; to prohibit the movement of all such weeds in interstate or foreign commerce except under

permit; to inspect, seize and destroy products, and to quarantine areas, if necessary to prevent the spread of such weeds; and to cooperate with other Federal, state and local agencies, farmers associations, and private individuals in measures to control, eradicate, prevent, or retard the spread of such weeds.

Federal Water Pollution Control Act and Amendments of 1972 (Clean Water Act)

Enacted to restore and maintain the chemical, physical, and ecological integrity of the Nation's waters. Provides for measures to prevent, reduce, and eliminate water pollution; recognizes, preserves, and protects the responsibilities and rights of States to prevent, reduce, and eliminate pollution, and to plan the development and use (including restoration, preservation, and enhancement) of land and water resources; and provides for Federal support and aid of research relating to the prevention, reduction, and elimination of pollution, and Federal technical services and financial aid to state and interstate agencies and municipalities for the prevention, reduction, and elimination of pollution.

Established goals for the elimination of water pollution; required all municipal and industrial wastewater to be treated before being discharged into waterways; increased Federal assistance for municipal treatment plant construction; strengthened and streamlined enforcement policies; and expanded the Federal role while retaining the responsibility of states for day-to-day implementation of the law.

Fish and Wildlife Conservation Act of September 15, 1960

Requires the Secretaries of the Interior and Agriculture, in cooperation with state agencies, to plan, develop, maintain, and coordinate programs for the conservation and rehabilitation of wildlife, fish, and game on public lands under their jurisdiction.

Food, Conservation & Energy Act of 2008 (2008 Farm Bill)
Public Law 110-246 Title VIII – Forestry, Subtitle A, B, and C

Subtitle A: Amendment to the Cooperative Forestry Assistance Act of 1978. Establishes national priorities for private forest conservation, a community forest and open space conservation program, and a Secretary level forest resources coordinating committee.

Subtitle B: Cultural and Heritage Cooperation Authority. Authorizes the Secretary of Agriculture to provide forest products to Indian tribes for traditional and cultural purposes; to protect the confidentiality of certain information, including information that is culturally sensitive to Indian tribes; to utilize National Forest System land for the reburial of human remains and cultural items, including human remains and cultural items repatriated under the Native American Graves Protection and Repatriation Act; prevent the unauthorized disclosure of information regarding human remains or cultural items reburied on National Forest System land; to ensure access to National Forest System land, to the maximum extent practicable, by Indians and Indian tribes for traditional and cultural purposes; to increase the availability of Forest Service programs and resources to Indian tribes in support of the policy of the United

States to promote tribal sovereignty and self-determination; and to strengthen support for the policy of the United States of protecting and preserving the traditional, cultural, and ceremonial rites and practices of Indian tribes, in accordance with the American Indian Religious Freedom Act (42 U.S.C. 1996).

Subtitle C: Amendments to Other Forestry Related Laws. Amends the Lacey Act to include the illegal taking of plants, establishes an Emergency Forest Restoration Program, and renews authority and funding for the Healthy Forest Reserve Program.

Forest and Rangeland Renewable Resources Planning Act of August 17, 1974

Directs the Secretary of Agriculture to prepare a renewable resource assessment every 10 years; to transmit a recommended renewable resources program to the President every 5 years; to develop, maintain, and, as appropriate, revise land and resource management plans for units of the National Forest System; and to ensure that the development and administration of the resources of the National Forest System are in full accord with the concepts of multiple use and sustained yield.

Freedom of Information Act of November 21, 1974

Governs which government records are released to the public either automatically or upon request.

Healthy Forests Restoration Act of 2003 (H.R. 1904)

Purposes are to reduce wildfire risk to communities and municipal water supplies through collaborative hazardous fuels reduction projects; to assess and reduce the risk of catastrophic fire or insect or disease infestation; to enhance efforts to protect watersheds and address threats to forest and rangeland health (including wildfire) across the landscape; to protect, restore, and enhance forest ecosystem components such as biological diversity, threatened/endangered species habitats, and enhanced productivity.

Historic Sites Act of 1935 (16 U.S.C. 461)

Establishes a policy to preserve for public use historic sites, buildings, and objects of national significance for the benefit of the people. Authorizes the National Park Service's National Historic Landmarks Program.

Land and Water Conservation Fund Act of September 3, 1964

Authorizes the appropriation of funds for Federal assistance to states in planning, acquisition, and development of needed land and water areas and facilities and for the Federal acquisition and development of certain lands and other areas for the purposes of preserving, developing, and assuring accessibility to outdoor recreation resources.

Mineral Leasing Act of February 25, 1920

Provides that the deposits of certain minerals on land owned by the United States shall be subject to lease to citizens of the United States, provided royalties on such deposits are paid to the United States.

Mining and Minerals Policy Act of December 31, 1970

States that it is the policy of the Federal Government to foster and encourage the development of economically sound and stable domestic mining, minerals, metal, and mineral reclamation industries; the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security, and environmental needs; mining, mineral, and metallurgical research to promote the wise and efficient use of our natural and reclaimable mineral resources; and the study and development of methods for the disposal, control, and reclamation of mineral waste products and the reclamation of mined land.

Multiple-Use Sustained-Yield Act of June 12, 1960

States that it is the policy of Congress that the national forests are established and shall be administered for outdoor recreation, range, timber, watershed, and wildlife and fish purposes, and authorizes and directs the Secretary of Agriculture to develop and administer the renewable surface resources of the national forests for the multiple use and sustained yield of products and services.

National Environmental Policy Act of January 1, 1970

Directs all Federal agencies to consider and report the potential environmental impacts of proposed Federal actions and established the Council on Environmental Quality.

National 1990 Farm Bill (Title XII – Forest Stewardship Act) Act of November 28, 1990

Directs the Secretary of Agriculture to establish a competitive forestry, natural resources, and environmental grants program, and provides for other research programs.

National Forest Management Act of October 22, 1976

The National Forest Management Act reorganized, expanded, and otherwise amended the Forest and Rangeland Renewable Resources Planning Act of 1974, which called for the management of renewable resources on National Forest System lands. The National Forest Management Act requires the Secretary of Agriculture to assess forest lands, develop a management program based on multiple-use, sustained-yield principles, and implement a resource management plan for each unit of the National Forest System. It is the primary statute governing the administration of national forests.

National Historic Preservation Act of 1966 as amended (NHPA) (16 U.S.C. 470)

Sets forth the Federal Government's policy to preserve and protect historical and cultural resources. This act states that the historical and cultural foundations of the Nation should be preserved as a living part of the Nation's community life and development in order to give a sense of orientation to the American people. Directs all Federal agencies to take into account the effects of their undertakings (actions, financial support, and authorizations) on properties included in or eligible for the National Register. Establishes inventory, nomination, protection, and preservation responsibilities for federally owned historic properties. As amended extends the policy in the Historic Sites Act to State and local historical sites as well as those of national significance, expands the National Register of Historic Places, establishes the Advisory Council on Historic Preservation and the State Historic Preservation Officers, and requires agencies to designate Federal preservation officers. Establishes criteria for designating tribal historic preservation officers to assume the functions of a state historic preservation officer on tribal lands.

National Trails System Act of October 2, 1968 (16 U.S.C.1241-1251)

Created a series of National trails "to promote the preservation of, public access to, travel within, and enjoyment and appreciation of the open-air, outdoor areas and historic resources of the Nation." The Act and its subsequent amendments authorized a national system of trails and defined four categories of national trails. National Scenic Trails (NST) provide outdoor recreation and the conservation and enjoyment of significant scenic, historic, natural, or cultural qualities;
National Historic Trails (NHT) follow travel routes of national historic significance; National Recreation Trails (NRT) are in, or reasonably accessible to, urban areas on federal, state, or private lands; and Connecting or Side Trails provide access to or among the other classes of trails.

Organic Administration Act of June 4, 1897

Authorizes the President to modify or revoke any instrument creating a national forest; states that no national forest may be established except to improve and protect the forest within its boundaries, for the purpose of securing favorable conditions of waterflows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States. Authorizes the Secretary of Agriculture to promulgate rules and regulations to regulate the use and occupancy of the national forests.

Public Rangelands Improvement Act of October 25, 1978

Establishes and reaffirms the national policy and commitment to inventory and identify current public rangeland conditions and trends; manage, maintain and improve the condition of public rangelands so that they become as productive as feasible for all rangeland values in accordance with management objectives and the land use planning process; charge a fee for public grazing use which is equitable; continue the policy of protecting wild free roaming horses and burros from capture, branding, harassment, or death, while at the same time

facilitating the removal and disposal of excess wild free roaming horses and burros which pose a threat to themselves, their habitat, and to other rangeland values.

Religious Freedom Restoration Act (RFRA) (42 U.S.C. § 2000bb)

Government shall not substantially burden a person's exercise of religion even if the burden results from a rule of general applicability, except when the government demonstrates that application of the burden to the person is in furtherance of a compelling governmental interest; and is the least restrictive means of furthering that compelling governmental interest.

Secure Rural Schools and Community Self-Determination Act of 2000

Through this law the Forest Service gives rural communities the means to build and improve schools, and provide road maintenance, emergency services, and conservation programs for their citizens. Thus, communities are no longer dependent on Federal timber sales from national forests to improve local schools and roads.

Sikes Act of October 18, 1974, as amended

Authorizes the Secretary of the Interior and the Secretary of the Agriculture, in cooperation with the State agencies, to develop, maintain, and coordinate programs on public lands under their jurisdiction for the conservation and rehabilitation of wildlife, fish, and game. Provides that no individual will be permitted to hunt, trap, or fish on any public land within the State which is subject to a conservation and rehabilitation program under this section unless he/she has a valid public land management stamp. Makes provisions for the issuance and sale of such stamps.

Small Tracts Act of January 22, 1983

Authorizes the Secretary of Agriculture to sell, exchange, or interchange by quitclaim deed all right, title and interest, including the mineral estate, of the United States in and to certain lands within the national forest when he/she determines it to be in the public interest.

Tribal Forest Protection Act of 2004 (Public Law 108-278)

Authorizes the Secretary of Agriculture and the Secretary of the Interior to enter into an agreement or contract with Indian tribes meeting certain criteria to carry out projects to protect Indian forest land.

U.S. Mining Laws (Public Domain Lands) Act of May 10, 1872

Provides that all valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are free and open to exploration and purchase, and the lands in which they are found to occupation and purchase by citizens of the United States and those who have declared their intention to become such, under regulations prescribed by law, and according to the local customs or rules of miners, so far as the same are applicable and not

inconsistent with the laws of the United States. There are a number of acts which modify the mining laws as applied to local areas by prohibiting entry altogether or by limiting or restricting the use which may be made of the surface and the right, title, or interest which may pass through patent.

Wild Free-Roaming Horses and Burros Act of December 15, 1971, as amended by Federal Land Policy Management Act of 1976 and Public Rangelands Improvement Act of 1978

Protects wild free roaming horses and burros from capture, branding, harassment, or death; and states they are to be considered in the area where presently found an integral part of the natural system of the public lands.

Wild and Scenic Rivers Act of October 2, 1968

Instituted a National Wild and Scenic Rivers System by designating the initial components of that system, and by prescribing the methods by which and standards according to which additional components may be added to the system from time to time.

Wilderness Act of September 3, 1964

Established a National Wilderness Preservation System to be composed of federally owned areas designated by Congress as “wilderness areas” and administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness. Provides for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness. States that no Federal lands shall be designated as “wilderness areas” except as provided for in the act or by a subsequent act.

Kaibab NF wilderness areas are designated under the following authorities:

> **Arizona Wilderness Act of 1984** (Public Law 48-406) designates Kanab Creek, Kendrick Mountain, and Saddle Mountain areas.

Regulations

Below is a partial listing of relevant regulations. Federal executive departments and administrative agencies write regulations to implement laws. Regulations are secondary to law. However, both laws and regulations are enforceable.

36 CFR 60 National Register of Historic Places

Sets forth the procedural requirements for listing properties on the National Register.

36 CFR 63 Determinations of Eligibility for Inclusion in the National Register of Historic Places

Developed to assist agencies in identifying and evaluating the eligibility of properties for inclusion in the National Register, and to explain how to request determinations of eligibility.

36 CFR 62 National Natural Landmarks Program

The procedures in this part set forth the processes and criteria for the identification, evaluation, designation, and monitoring of national natural landmarks.

36 CFR 65 National Historic Landmarks Program

Sets forth the criteria for establishing national significance and the procedures used by the Department of the Interior for conducting the National Historic Landmarks Program.

36 CFR 212 Forest Development Transportation System[26]

Sets forth the requirements for the development and administration of the forest development transportation system.

36 CFR 219 Planning

Sets forth a process for developing, adopting, and revising land and resource management plans for the National Forest System.

36 CFR 221 Timber Management Planning

Sets forth the requirements for management plans for national forest timber resources.

36 CFR 222 Range Management

Sets forth the requirements for range management on the national forests, and for the administration of wild and free roaming horses and burros and their environment. See Subpart B (Management of Wild Free-Roaming Horses and Burros).

36 CFR 223 Sale and Disposal of National Forest System Timber

Sets forth the requirements relating to the sale and disposal of National Forest System timber.

36 CFR 228 Minerals

Sets forth the rules and procedures through which use of the surface of National Forest System lands, in connection with mining and mineral operations, shall be conducted so as to minimize adverse environmental impacts on National Forest System surface resources.

36 CFR 241 Fish and Wildlife

Sets forth the rules and procedures relating to the management, conservation, and protection of fish and wildlife resources on National Forest System lands.

[26] Travel Management; Designated Routes and Areas for Motor Vehicle Use; Final Rule is found in 36 CFR 212, 251, 261, and 295

36 CFR 251 Land Uses

Sets forth the rules and procedures relating to the use and occupancy of National Forest System lands.

36 CFR 254 Landownership Adjustments

Sets forth the rules and procedures relating to exchange and conveyance of National Forest System lands.

36 CFR 261 Prohibitions

Sets forth the general prohibitions relating to the use and occupancy of National Forest System lands.

36 CFR 293 Wilderness-Primitive Areas

Sets forth the requirements for the administration of wilderness and primitive areas.

36 CFR 294 Special Areas

Sets forth the requirements for designation of special recreation areas.

36 CFR 295 Use of Motor Vehicles Off Forest Development Road

Sets forth the rules and procedures relating to the administrative designation and location of specific areas and trails of National Forest System lands on which the use of motor vehicles traveling off of national forest development roads is allowed.

36 CFR 296 Protection of Archaeological Resources: Uniform Regulations

Implements the Archaeological Resources Protection Act by establishing the uniform definitions, standards, and procedures for Federal land managers to follow in providing protection for archaeological resources located on public lands and Indian lands, including definitions of prohibited acts and penalties. The regulations also provide requirements for issuing permits under the authority of the Archaeological Resources Protection Act to any person proposing to excavate and/or remove archaeological resources from public lands or Indian lands.

36 CFR 297 Wild and Scenic Rivers

Sets forth the rules and procedures relating to Federal assistance in the construction of water resources projects affecting wild and scenic rivers or study rivers on lands administered by the Secretary of Agriculture.

36 CFR 800 Protection of Historic Properties

Sets forth the provisions for the administration of the National Historic Preservation Act.

40 CFR 51.300-309 Regional Haze Rule

The primary purposes of this subpart are to require states to develop programs to assure reasonable progress toward meeting the national goal of preventing any future, and remedying any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from manmade air pollution; and to establish necessary additional procedures for new source permit applicants, states and Federal land managers to use in conducting the visibility impact analysis required for new sources under §51.166. This subpart sets forth requirements addressing visibility impairment in its two principal forms: "reasonably attributable" impairment (i.e., impairment attributable to a single source/small group of sources) and regional haze (i.e., widespread haze from a multitude of sources which impairs visibility in every direction over a large area).

40 CFR 1500 Council on Environmental Quality

Council on Environmental Quality regulations implementing the National Environmental Policy Act.

43 CFR 3 Preservation of American Antiquities

Implements the provisions of the Antiquities Act of 1906.

43 CFR 10 Native American Graves Protection and Repatriation Act Regulations

Implements the provisions of the Native American Graves Protection and Repatriation Act of 1990.

49 CFR 24.102, 103, 104 Basic Acquisition Policies, Criteria for Appraisals, Review of Appraisals

Real property acquisition.

50 CFR 402 Regulations Governing Interagency Cooperation—Endangered Species Act of 1973, as amended

Interprets and implements the act. Addresses forms of consultation (early, formal, informal and emergency), conferencing, preparation of biological assessments, designation of lead agency, responsibilities of Federal agency following issuance of a biological opinion, reinitiation of formal consultation, and irreversible or irretrievable commitment of resources.

Executive Orders

Below is a partial listing of relevant executive orders. Executive orders are official documents by which the President provides instructions to executive departments and agencies. An executive order may be used to reassign functions among executive branch agencies. It may adopt guidelines, rules of conduct, or rules of procedure for government employees or units of government. It can also establish an advisory body or task force.

Executive Order 11990 Protection of Wetlands, 1977

Requires each Federal agency to provide leadership and to take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for acquiring, managing, and disposing of Federal lands and facilities; providing federally undertaken, financed, or assisted construction and improvements; and conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.

Executive Order 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, 1994

Addresses environmental justice in minority and low-income populations and is designed to focus Federal attention on the environmental and human health conditions in minority communities and low-income communities with the goal of achieving environmental justice. The order is also intended to promote nondiscrimination in Federal programs substantially affecting human health and the environment, and to provide minority communities and low-income communities access to public information on, and an opportunity for public participation in, matters relating to human health or the environment.

Executive Order 13007 Indian Sacred Sites, 1996

Requires each executive branch agency with statutory or administrative responsibility for the management of Federal lands, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and to avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies shall maintain the confidentiality of sacred sites.

Executive Order 13112 Invasive Species, 1999

Ensures that Federal programs and activities to control and prevent invasive species are coordinated, effective, and efficient. It defines invasive species as "…an alien (or nonnative) whose introduction does or is likely to cause economic or environmental harm or harm to human health."

Executive Order 13175 Consultation and Coordination with Indian Tribal Governments, 2000

Promotes regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications, strengthens the United States government-to-government relationships with Indian tribes, and reduces the imposition of unfunded mandates upon Indian tribes.

Executive Order 13186 Responsibility of Federal Agencies to Protect Migratory Birds, 2001

Directs Federal agencies, as practicable, to support the conservation of migratory birds, restore and enhance the habitat of migratory birds, prevent or abate pollution or detrimental alteration of the environment for the benefit of migratory birds, ensure agency plans and actions promote programs and recommendations of comprehensive migratory bird planning efforts such as Partners-in-Flight, ensure that environmental analyses of Federal actions required by NEPA evaluate effect on migratory birds, and promote research, education, and training related to conservation of migratory birds.

Executive Order 13195 Trails for America in the 21st Century

"Federal agencies will… protect, connect, promote, and assist trails of all types… This will be accomplished by… protecting the trail corridors associated with National Scenic Trails… to the degree necessary to ensure that the values for which [the] trail was established remain intact."

Executive Order 13423 Strengthening Federal Environmental, Energy, and Transportation Management, 2007

Directs Federal agencies to conduct their environmental, transportation, and energy-related activities in support of their respective missions in an environmentally, economically and fiscally sound, integrated, continuously improving, efficient, and sustainable manner.

Executive Order 13433 Facilitation of Hunting Heritage and Wildlife Conservation, 2007

Directs Federal agencies with programs and activities that have a measureable effect on public management, outdoor recreation, and wildlife management, to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat.

Forest Service Directives

The following is a partial listing of national and regional Forest Service policies relevant to this plan. A complete listing can be found in Forest Service Manuals and Forest Service Handbooks at http://www.fs.fed.us/im/directives/

The directives system is the primary basis for the management and control of all internal programs and serves as the primary source of administrative direction for Forest Service employees. The system sets forth legal authorities, management objectives, policies, responsibilities, delegations, standards, procedures, and other instructions.

The Forest Service Manual (FSM) contains legal authorities, goals, objectives, policies, responsibilities, instructions, and the necessary guidance to plan and execute assigned programs and activities. Forest Service Handbooks (FSH) are directives that provide instructions and guidance on how to proceed with a specialized phase of a program or

activity. Handbooks either are based on a part of the FSM or they incorporate external directives. Forest Service Manuals and applicable Forest Service Handbooks provide guidance only and do not provide required direction.

FSM 1000 Organization and Management

- **FSM 1010** Laws, Regulations, and Orders
- **FSM 1020** Forest Service Mission

FSM 1400 Controls

- **FSM 1410** Management Reviews

FSM 1500 External Relations

- FSM 1560 State, Tribal, County, and Local Agencies, Public and Private Organizations

FSM 1600 Information Resources

FSM 1900 Planning

- **FSM 1920** Land and Resource Management Planning
- **FSM 1950** Environmental Policy and Procedures

FSM 2000 National Forest Resource Management

- **FSM 2060** Ecosystem Classification, Interpretation, and Application
- **FSM 2070** Biological Diversity
  - **FSM 2070.3** Vegetation Ecology (use of native plants in revegetation, rehabilitation, and restoration)
- **FSM 2080** Noxious Weed Management, Southwestern Region supplement (weed free policy)

FSM 2200 Range Management

- **FSM 2260** Wild Free-Roaming Horses and Burros

FSM 2300 Recreation, Wilderness, and Related Resource Management

- **FSM 2320** Wilderness Management
- **FSM 2330** Publicly Managed Recreation Opportunities
  - FSM 2332.11 Hazard Trees
- **FSM 2350** Trail, River, and Similar Recreation Opportunities
- **FSM 2353.4** Administration of National Scenic and National Historic Trails
  - FSH 2309.18 Trails Management Handbook
- **FSM 2360** Heritage Program Management
  - FSM 2300-99-3 Southwest Region Supplement

FSM 2400 Timber Management, Southwestern Region.

- **FSM 2430** Commercial Timber Sales, Southwestern Region, Small Sales and Commercial/Personal Use Permits of Timber, Fuelwood, and other forest products
- **FSM 2470** Silvicultural Practices

FSM 2500 Watershed and Air Management

- **FSM 2540** Water Uses and Development, Southwestern Region supplement
  - FSH 2509.25 Watershed Conservation Practices Handbook

FSM 2600 Wildlife, Fish, and Sensitive Plant Habitat Management

- **FSM 2610** Cooperative Relations
- **FSM 2630** Management of Wildlife and Fish Habitat
- **FSM 2670** Threatened, Endangered and Sensitive Plants and Animals

FSM 2700 Special Uses Management

- **FSM 2726** Energy Generation and Transmission
- **FSM 2728** Communications
  - FSH 2709.11 Special Uses Handbook
  - FSH 2709.14 Recreation Special Uses Handbook

FSM 2800 Minerals and Geology

- **FSM 2810** Mining Claims
- **FSM 2820** Mineral Leases, Permits, Licenses
- **FSM 2850** Mineral Materials
  - FSH 2809.15 Minerals and Geology Handbook

FSM 3100 Cooperative Fire Protection

FSM 3400 Forest Pest Management

FSM 5100 Fire Management

FSM 5400 Land Ownership

- **FSM 5410** Appraisals
- **FSM 5420** Land Purchases and Donations
  - FSH 5409.13 Land Acquisition Handbook
- **FSM 5430** Exchanges
- **FSM 5460** Right-of-Way Acquisition
  - FSH 5409.17 Rights-of-Way Acquisition Handbook

FSM 5500 Land Ownership Title Management

FSM 7300 Buildings and Other Structures

- **FSM 7310** Buildings and Related Facilities
  - FSH 7309.11 Buildings and Related Facilities Handbook

FSM 7400 Public Health and Pollution Control Facilities

- **FSM 7420** Drinking Water

FSM 7500 Water Storage and Transportation

FSM 7700 Transportation System

- **FSM 7710** Travel Planning
  - FSH 7709.55 Travel Analysis
  - FSH 7709.56 Preconstruction Handbook
  - FSH 7709.57 Road Construction Handbook
- **FSM 7720** Development (Policy on Transportation)
- **FSM 7730** Operation and Maintenance
- **FSM 7731** FSH 7709.59 Road Operations

State Regulations

Arizona Administrative Code, Title 18. Environmental Quality, Chapter 2. Department of Environmental Quality Air Pollution Control, Article 15. Forest and Range Management Burns. http://www.azsos.gov/public_services/Title_18/18-02.htm

Arizona Administrative Code, Title 18. Environmental Quality, Chapter 4. Department of Environmental Quality Drinking Water Regulations.
http://www.azsos.gov/public_services/title_18/18-04.htm

Arizona Administrative Code, Title 18. Environmental Quality, Chapter 5. Department of Environmental Quality Environmental Reviews and Certification.
http://www.azsos.gov/public_services/title_18/18-05.htm

Arizona Administrative Code, Title 18. Environmental Quality, Chapter 9. Department of Environmental Quality Water Pollution Control.
http://www.azsos.gov/public_services/title_18/18-05.htm

Arizona Administrative Code, Title 18. Environmental Quality, Chapter 11. Department of Environmental Quality Water Quality Standards.
http://www.azsos.gov/public_services/title_18/18-11.pdf

Arizona Department of Environmental Quality Regional Haze State Implementation Plan for the State of Arizona. http://www.azdeq.gov/environ/air/haze/download/2sip.pdf

Arizona Department of Environmental Quality Revision State Implementation Plan for Regional Haze.
http://www.azdeq.gov/environ/air/haze/download/2004_RH_SIP_Revision.pdf

Arizona Revised Statute, Title 17 – Game and Fish, Section 308. Unlawful camping relative to water and wildlife or domestic stock access.
http://www.azleg.gov/ArizonaRevisedStatutes.asp?Title=49

Arizona Revised Statute, Title 49 – The Environment, Chapter 2 Water Quality Control, Article 3.1 Arizona Pollutant Discharge Elimination System Program.
http://www.azleg.gov/ArizonaRevisedStatutes.asp?Title=49

Programmatic Agreements

The Memorandum of Understanding (04-MU-110460000-060) between the USDA Forest Service, Southwestern and Intermountain Regions and the State of Utah jointly identifies priority restoration needs; to build capacity to accomplish needed restoration projects; and to expand the use of stewardship contracting or other tools that encourage local employment in order to benefit the management of the national forests and communities of the Central Colorado Plateau and Great Basin.

A Memorandum of Understanding between the Forest Service, Southwestern Region, and the State of Arizona Department of Environmental Quality outlines responsibilities and activities related to water quality.

Memorandum of Understanding between the Havasupai I Tribe and the USDA Forest Service, Kaibab National Forest (2008).

Memorandum of Understanding between the Hopi Tribe and the USDA Forest Service, Kaibab National Forest (2004).

Memorandum of Understanding between the Hualapai Tribe and the USDA Forest Service, Kaibab National Forest (2007).

Memorandum of Understanding between the Kaibab Band of Paiute Indians and the USDA Forest Service, Kaibab National Forest (2008).

Memorandum of Understanding between the National Speleological Society and the USDA Forest Service, (2011).

Various memorandums of understanding with other agencies and organizations to promote conservation of migratory birds, to recover California condor, to facilitate survey and monitoring of bats and bat habitat with Bat Conservation International, and to improve coordination between Arizona Game and Fish Department and the Forest Service Southwestern Region.

First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities among New Mexico Historic Preservation Officer and Arizona State Historic Preservation Officer and Texas State Historic Preservation Officer and Oklahoma State Historic Preservation Officer and the Advisory Council on the Historic Preservation and United States Department of Agriculture Forest Service Southwestern Region.

Other

Arizona Bugbane Conservation Assessment and Strategy for the Coconino and Kaibab National Forests (USDA FS 1995). The character of this area is maintained by limiting access and managing threats. Suppression actions may be needed to prevent damage to the plant colony and habitat.

Arizona Department of Transportation 2005. Historic Route 66 Corridor Management Plan. http://www.azdot.gov/Highways/SWProjMgmt/enhancement_scenic/scenicroads/PDF/cmp_route_66.pdf

Central Arizona Grotto 2013. Arizona National Forest Cave and Karst Management Plan http://centralarizonagrotto-cavemanagement.webstarts.com/cave_management_plans.html lKaibab National Forest Recreation Opportunity Spectrum-Scenery Management Guidebook, Kaibab National Forest Recreation Facility Analysis, Forest Service Built Environment Design Guide, ROS Book

Kaibab and Coconino National Forests Official Policy on Forest Products for Traditional and Cultural Purposes-2011

National Wildfire Coordinating Group (NWCG) Review and Update of the Federal Wildland Fire Management Policy (2001)
http://www.nwcg.gov/branches/ppm/fpc/archives/fire_policy/index.htm

National Interagency Fire Center (NIFC) Guidance for Implementation of Federal Wildland Fire Management Policy (2009) http://www.nifc.gov/policies/guidance/GIFWFMP.pdf

National Interagency Fire Center (NIFC) Interagency Prescribed Fire Planning and Implementation Guide (2008)
http://www.nifc.gov/fuels/downloads/directions/RXFireGuide_08.30.06.pdf

Paradine Plains Cactus (*Pediocactus paradinei*) Conservation Assessment and Strategy on the North Kaibab Ranger District, Kaibab NF and the Arizona Strip District, BLM 1997.

Parker, Patricia L. and Thomas F. King, 1998. Guidelines for Evaluating and Documenting Traditional Cultural Properties, National Register Bulletin, U.S. Department of the Interior, National Park Service, National Register, History and Education.

United Nations Declaration on the Rights of Indigenous People 07-58681—March 2008 — 4,000

USDA, Forest Service, Coconino National Forest 1987. Land Management Plan as amended June 1996. The Coconino NF plan provides direction for the Sycamore Canyon Wilderness which is located within and managed by three national forests—the Coconino, Kaibab, and Prescott NFs.

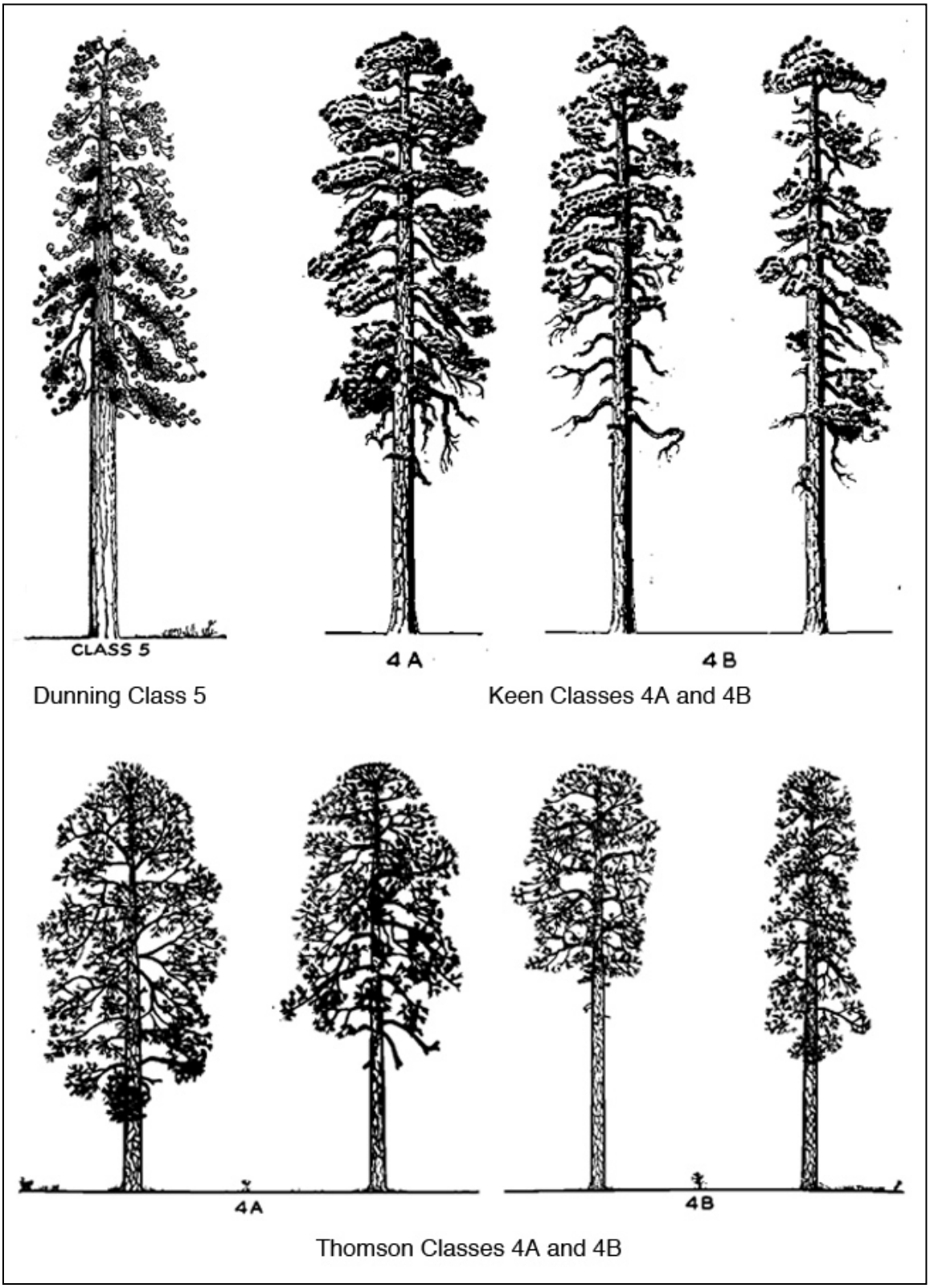
USDA, Forest Service, Kaibab National Forest, Williams RD 1984. Wild Burro Interim Management Plan: Double A wild burro territory.

USDA, Forest Service, Southwestern Region 2005. Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds: Coconino, Kaibab, Prescott National Forests within Coconino, Gila, Mojave, and Yavapai Counties, Arizona, MB-R3-16-1.

USDOE and USDOI 2008. Programmatic Final Environmental Impact Statement, Designation of Energy Corridors on Federal Lands in the 11 Western States. http://corridoreis.anl.gov/documents/fpeis/index.cfm#vol1

Wildland Fire Decision Support System (WFDSS)
http://wfdss.usgs.gov/wfdss/WFDSS_Home.shtml

Appendix C. Large Tree Retention Classes for Ponderosa Pine



Age Class Descriptions

Dunning (1928) Age Class 5: Overmature; usually largest trees in stand; bark light yellow with wide, long and smooth plates; tops flat with terminals rarely discernible; nearly all branches are drooping, gnarled, and crooked.

Keen (1943) Age Class 4: Overmature; making no further height growth; diameter growth very slow; bark light yellow, uniform for entire bole (except in extreme top), with wide, long and smooth plates and often shallow fissures; tops usually flat or occasionally rounded or irregular; branches large, heavy, and often gnarled or crooked and mostly drooping except in extreme top.

Thomson (1940) Age Class 4: Mature to overmature; trees usually large; bark reddish-brown to yellow with wide, long and smooth plates; tops usually flat and making no further height growth; branches mostly large and drooping, gnarled or crooked.

References

Dunning, D. 1928. A tree classification for the selection forests of the Sierra Nevada. *Journal of Agricultural Research* 36(9): 755–771.

Keen, F. P. 1943. Ponderosa pine tree classes redefined. *Journal of Forestry* 41(4): 249–253.

Thomson, W. G. 1940. A growth rate classification of Southwestern ponderosa pine. *Journal of Forestry* 38(7): 547–553.

Appendix D. Kaibab National Forest's Plan Revision Climate Change Approach

This appendix summarizes the Kaibab National Forest's climate change approach for plan revision and guidance excerpted from "Southwestern Climate Change Trends and Forest Planning: A Guide for Addressing Climate Change in Forest Plan Revisions for Southwestern National Forests and National Grasslands" (USDA 2010a).

Introduction

Climate scientists agree that the earth is undergoing a warming trend, and that human-caused elevations in atmospheric concentrations of carbon dioxide and other greenhouse gases are among the causes of global temperature increases. The observed concentrations of these greenhouse gases are projected to increase. Climate change may intensify the risk of ecosystem change for terrestrial and aquatic systems, thereby affecting ecosystem structure, function, and productivity.

Strategies for protecting climate sensitive ecosystems through management will become increasingly important because changes in climate will likely continue regardless of emissions mitigation. Climate change exacerbates the already difficult task of managing the National Forest System for multiple goals. This appendix summarizes how the Kaibab NF intends to incorporate current and possible future climate change into the land management planning process. The primary consideration for evaluating responses to climate change lies with the Kaibab NF's ability to modify social, economic, and ecological conditions on the planning unit.

Current Conditions and Trends

Current conditions and trends described in the final environmental impact statement (FEIS) for the Kaibab NF land and resource management plan and alternatives addresses risks, vulnerabilities, and potential ecological changes that could result from climate change. The plan addresses potential climate change impacts that are most likely to affect ecological systems, goods, and services. Evaluation of climate change impacts may lead to recognition that some conditions may be difficult to maintain over time. Particular attention is given to ecosystems that are most at risk due to climate change and vulnerable ecosystem components, such as aquatic systems, grassland plant diversity, and high-elevation ecosystems. Information from the evaluation of current conditions and trends was used to develop the social, economic, and ecological desired conditions in the plan.

Integrating Climate Change into Land and Resource Management Plans

Climate change is addressed as an integrated part of this plan rather than as a standalone set of desired conditions. An example is the desired condition that "The composition, structure, and function of vegetative conditions are resilient to the frequency, extent, and severity of disturbances and components that provide resilience to climate variability." Integration of climate-relevant desired conditions throughout the plan helps to ensure these concepts are considered during project-level planning.

Desired conditions for the planning unit were developed considering potential climate effects to:

- Increased extreme weather related forest disturbances (floods, drought, wind-throw)

- Water stresses (groundwater, runoff, and timing), aquatic biota
- Wildfire risks
- Shifts in major vegetation types for the Southwest
- Threatened, endangered, and sensitive species
- Forest insects and disease
- Weather related stresses on human communities (temperature, air quality)
- Outdoor recreation
- Wildlife movement and biodiversity

Monitoring

No specific element of the monitoring plan was developed solely for monitoring climate change. However, the plan monitoring program incorporates provisions that should improve understanding of the relationships between key plan components and climate change. For example, an inventory of the aquatic ecosystems and information about water temperatures and waterflows associated with climate change can be useful for tracking variability within ecosystem condition and trends observed over a prescribed evaluation period. Monitoring the frequency and spatial extent of uncharacteristic wildfire occurrences and insect outbreaks would help the Kaibab NF assess how well management is mitigating for hotter, drier, and more fire-prone conditions, and whether existing management is promoting resilient ecosystems. Along similar lines, monitoring springs that are sensitive to variable precipitation and naturally more predisposed to the effects of prolonged drought would help the Kaibab NF to prioritize protection and restoration focused on those ecosystems while gleaning information about endemic species levels and refugia. It may also be possible to discern climate change-related patterns in habitat use through long-term monitoring of songbirds and their habitat.

Although not an exhaustive list, some of the key Kaibab NF monitoring plan questions that have climate change relevance are:

- What percentage of the Kaibab NF is in an uneven-aged open state at the midscale (above 100 acres)?
- How many acres burned with desired fire behavior and effects?
- What is the total area of contiguous acres (above the midscale) at risk for active crown fire?
- What is functional condition of the natural lakes and wetlands?
- What are the areal extent, distribution, and abundance of priority nonnative invasive plants on the Kaibab NF?

As part of its 2010 to 2015 strategic plan, the Forest Service launched a "Roadmap for Responding to Climate Change" (USDA 2010b). This comprehensive science-based plan emphasized a set of long- and short-term approaches for managing climate change while providing the agency with a clear, common vision. This strategic plan should help the Forest Service better provide for sustainability over time with climate uncertainty. The roadmap focuses on three primary activity areas: (1) assessing current risks, vulnerabilities, policies, and gaps in knowledge; (2) engaging internal and external partners in seeking solutions; and (3) managing for resilience in ecosystems as well as in human communities. A component of the strategic plan is a "Performance Scorecard" (http://www.fs.fed.us/climatechange/pdf/Scorecard.pdf), to be

completed annually by each national forest or grassland. This scorecard has a series of questions focused on the above three activity areas that allow each management unit to assess how well integration of climate change considerations is happening at the local scale. The scorecard assesses agency capacity, partnerships and education, adaptation, mitigation, and sustainable consumption. All forests are expected to be compliant with 7 of the 10 scorecard elements by 2015.

Decision Documents

Pertinent aspects of climate change would be addressed in the rationale of decision documents, particularly those that may affect the social, economic, and ecological systems within the planning unit that are most at risk. Examples of ecosystems, characteristics, and species most at risk include fire-adapted vegetation, native aquatic species, and endemic species. Examples of socioeconomic systems at risk of change include risks to private property and infrastructure from uncharacteristic fires, livestock grazing, winter recreation, water recreation, and personal use products. Increasingly, tools are available to aid in understanding and evaluating how climate change could affect forest resources. These tools can help with describing existing conditions and trends, developing project design criteria, and evaluating potential effects as they relate to changing conditions (see planning tools below).

Potential Climate Change Effects

Based on current projections, the primary regional level effects of climate change most likely to occur in the Southwest include: (1) warmer temperatures, (2) decreasing precipitation, (3) decreased water availability with increased demand, (4) increased extreme disturbance events, and (5) increased use of national forests for relief from higher temperatures in lower elevation cities. These climate change factors could, in turn, affect ecological, weather related disturbances, and socioeconomic demands, including increases in:

- Frequency of extreme weather events (intense storms);
- Wildfire risks;
- Outbreaks of insects, diseases, and spread of nonnative invasive species;
- Demand for water;
- National forest socioeconomic uses and demands; and
- Changes in habitat quality and quantity for certain desired wildlife and plant species.

Extreme Weather Events

Climate change would likely increase flash floods, making the region's growing population more susceptible to loss of life and property. While the Southwest is expected to become warmer and drier, it is also likely to experience more flooding. This relates in part to the fact that warm air holds more moisture than cooler air. The frequency of floods is also influenced by the rate of snowmelt in the winter and spring, the character of the summer monsoon, and the incidence of tropical hurricanes and storms in the autumn.

Hurricanes and other tropical cyclones are projected to become more intense in the future. Since Arizona typically receives10 percent or more of its annual precipitation from tropical storms, it is likely that this change would also increase flooding. A potential increase in extreme storms, floods, heat waves, and droughts may present challenges for achieving desired conditions.

Impacts from extreme weather events could include changes in the composition and diversity of desired ecosystems; destruction of habitat; damage to infrastructure such as trails, facilities, and roads; loss of recreation opportunities; and reduced wood and forage supplies. Disturbances that exceed the historic range of natural variation can change the composition, structure, and function of watersheds and some vegetation types, affecting a wide range of resources. Heavy rains and higher flood levels could affect the structural integrity of built infrastructure and increase maintenance needs. Flooding is a natural and beneficial disturbance in many aquatic systems. However, damage to aquatic systems from flash flooding causes erosion, downed trees, and inundation that can change streamside habitats, affect aquatic life, and impact the functioning condition of stream channels. These disturbances could create challenges in the ability of a forest to achieve desired conditions for aquatic habitats. Overall, increasing weather-related disturbances could divert limited Forest staff and funding to recovery efforts for extended periods, which would delay progress toward desired conditions, or modify them to allow for more dynamic conditions when desired conditions may not be attainable.

Wildfire

Historically, wildfires have played an important role in the vitality of fire-adapted ecosystems. Past forest management and fire suppression practices have changed the dynamics of fire on the landscape within the Southwestern Region's national forests and grasslands, resulting in greater fuel loads and risk of wildfire. Federal land management agencies in the West routinely exceed expenditures of over $1 billion per year for wildfire suppression. Since about the mid-1970s, the total acreage of area burned and the severity of wildfires in ponderosa pine and mixed conifer forest have increased.

Fire frequency and severity are likely to increase as temperatures rise and precipitation decreases. Severe wildfires reduce the land's ability to sequester and store carbon. Population growth in the Southwest may also lead to greater numbers of human-caused wildfires. The 2002 Rodeo-Chediski Fires and the 2011 Wallow Fire in Arizona were started by humans. Combined, these fires burned over a million acres.

Outbreaks of Insects, Diseases, and Nonnative Invasive Species

Disturbances associated with climate change can have secondary impacts indirectly caused by wildfire and climate related extremes. Increased variation in temperature and moisture can cause stress and increase the susceptibility of forest ecosystems to invasions by insects, diseases, and nonnative species. New environmental conditions can lead to a different mix of species that tend to favor plants and animals that can adapt their biological functions or are aggressive in colonizing new territories (Whitlock 2008). However, changes in adaptability may be too slow given the predicted rate of change. Species that are already broadly adapted may become more prevalent and species with narrow adaptability may become less prevalent. Disturbance factors that create more vulnerability in native ecosystems or require extensive controls to maintain the status quo are likely to adversely affect the health and diversity of forests.

Desired conditions for healthy forests include resilience to dramatic changes caused by abiotic and biotic stressors and mortality agents (e.g. pine beetle) and a balanced supply of essential resources (light, moisture, nutrients, growing space). Insects and diseases typically invade in cycles followed by periods of relative inactivity. Nonnative invasive species, such as cheatgrass

and saltcedar, are expected to continue to increase in numbers and extent. Vulnerabilities to forest threats from an environment that may be much different from the historic range of natural variability is an active area of research, and includes developing new management approaches for changing conditions.

Diminishing Water Resources

Locations of most snowpack and upland reservoirs are on national forests in the Southwest. In much of the Southwest, less precipitation is falling as snow and spring melting is occurring earlier in the year. The Colorado River, Rio Grande, and several other southwestern rivers have streamflows that appear to be peaking earlier in the year, suggesting that the spring temperatures in these regions are warmer than in the past, causing snow to melt earlier. Water supplies are projected to become increasingly scarce, calling for tradeoffs among competing uses, potentially leading to conflict. In the Southwest, intense debate is likely to occur over resource allocation and conservation of available supplies.

Climate Related Socioeconomic Demand

Populations in Arizona and New Mexico are growing at an unprecedented rate. As of the American Communities Survey in 2006, Arizona's population was over 6 million. The total increase for Arizona between 1980 and 2006 was 123 percent. The combination of population growth and climate change would likely exacerbate climatic effects, putting even greater pressure on water, forests, and other resources. Climate change could have long-term impacts on many of the amenities, goods, and services from forests, including productivity of locally harvested plants; local economics through land use shifts from forest to other uses; forest real estate values; and tree cover and composition in urban areas and associated benefits and costs.

Climate Change and Wildlife Habitat

While climate change has the potential to affect all wildlife species, some are inherently more vulnerable than others, particularly species with specialized niches, limited mobility, and limited physiological adaptability. Certain habitats are more vulnerable to a changing climate. For example, springs and seeps are a valuable natural water source for a variety of birds and mammals, particularly in arid environments. These areas may offer critical refugia for rare and narrow endemic species. However, springs are especially sensitive to variable precipitation and likely to dry up during prolonged drought. As such, the unreliability of natural water resources would make it harder for wildlife species to persist, pushing the limits of their natural range.

Managing for landscape connectivity will be important, as connectivity facilitates movement of species among habitats (Taylor et al. 1993, Millar et al. 2007). Connectivity has two components, structural and biological connectivity and biological components. Structural connectivity, the spatial structure of a landscape, can be described from map elements. Biological connectivity is the response of individuals to the scale of landscape features (Brooks 2003). Promoting connectivity in landscapes with flexible management goals that can be modified as conditions change may assist species to respond naturally to changing climates. Reducing fragmentation and planning at landscape scales to maximize habitat connectivity will become increasingly important (Millar et al. 2007).

Management Strategies to Address Key Climate Change Concerns

Actions to address climate change factors of most concern are those that:

1. Reduce vulnerability by restoring and maintaining resilient native ecosystems;
2. Anticipate increases in forest recreation;
3. Use markets and demand for wood and biomass for restoration, renewable energy, and carbon sequestration;
4. Enhance adaptation by anticipating and planning for intense disturbances;
5. Conserve water; and
6. Monitor climate change influences.

Managing ecosystems under uncertainty necessitates flexible and adaptive approaches that are reversible, are implemented in incremental steps, allow for new information and learning, and can be modified with changing circumstances (Millar et al. 2007). Southwestern ecosystems have evolved under a long and complex history of climate variability and change. Taking into consideration the number of mega-droughts and other climate related variation, through time, southwestern systems have some built-in resilience. The revised plan focuses on restoring and maintaining resilience in forest and grassland ecosystems. Risks of increased wildfire, insects and disease outbreaks, and invasive species represent ongoing, broad-scale management challenges. These issues are not new. However, climate change has the potential to increase and exacerbate the impacts of these ecosystem risks.

Because our understanding of climate change is rapidly evolving, management decisions that are robust to uncertainty, while being both strategic and tactical in nature, would likely be most effective at managing for climate change. Peterson et al. (2011) have developed a guidebook for climate change response on national forests. It recommends the following strategies that incorporate both science and management: (1) become aware of basic climate change science and integrate that understanding with knowledge of the local resource conditions and issues (review); (2) evaluate sensitivity of natural resources to climate change (rank); (3) develop and implement options for adapting resources to climate change (resolve); and (4) monitor the effectiveness of on-the-ground management (observe) and adjust as needed.

Restoring and maintaining resilience would likely improve the potential for ecosystems to retain or return to desired conditions after being influenced by climate change related impacts and variability. Managing for resistance (e.g., maintenance thinning to prevent catastrophic fire, forest insect or disease pandemics) and resilience (e.g., noxious weed control) offer meaningful responses to climate change.

Prescribed fires are a management tool that can serve multiple purposes, from sustaining desired conditions for fire-adapted ecosystems and sustaining habitat for threatened and endangered species to reducing fuel loads. Prescribed burning is also a management strategy that will be important for maintaining desired habitats in a changing climate with more natural disturbances. With projections of more frequent storms and other more extreme weather events and increased stress from forest pests in a warmer, drier climate, prescribed burning will continue to be an important management strategy for the future.

Forests serve as significant carbon reservoirs; however, large-scale fire events can counter this benefit by releasing significant amounts of carbon into the atmosphere. Fuel treatments (e.g., thinning, prescribed fire), as identified in the proposed action, promote low-density stand structures characterized by larger, fire resistant trees. This strategy should afford greater carbon storage in southwestern fire-adapted ecosystems over time (North et al. 2009, Hurteau and North 2009). Although fire-excluded forests contain higher carbon stocks, this benefit is outweighed in the long term by the loss that would be likely from uncharacteristic stand-replacing fires (Hurteau et al. 2011) if left untreated.

Prescribed burning helps to mitigate the negative impacts of stand-replacing fire in dry, dense forests by consuming less biomass and releasing less carbon into the atmosphere (Wiedinmyer and Hurteau 2010). Further, research has shown that the long-term gains acquired through prescribed fire and mechanical thinning outweigh short-term losses in sequestered carbon. In the long term (e.g., 100 years), thinning and burning would create more resilient forests that are less prone to stand-replacing events, and subsequently able to store more carbon in the form of large trees.

Slash resulting from mechanical thinning can be used in place of fuels (North and Hurteau 2011, Sorenson et al. 2011). Not all forest products sequester carbon equally. For example, products with longer on average lifespans (e.g., houses), have a greater potential to store carbon than short-lived products such as fence posts. In addition, biomass products created from slash can be used in place of fossil fuels, greatly reducing carbon emission into the atmosphere (Ryan et al. 2010). These types of discussions of tradeoffs in emission and carbon storage rates are likely to be increasingly relevant in decision making. Wood products that can substitute for building materials such as steel and concrete produce far less greenhouse gas emissions during their production while simultaneously sequestering carbon (Ryan et al. 2010).

Although current programs and guidance are already in place to limit introduction of nonnative species, treat invasive species, and control insects and diseases, these efforts are likely to become more critical to maintaining desired conditions for healthy forests under a changing climate. Due to the fragmented land ownership patterns, success in reducing forest pests requires going beyond national forest boundaries, and continued collaboration with partners will be needed. In addition, management practices (such as prescribed selection cutting for age class diversity) that sustain healthy forests and provide adequate nutrients, soil productivity, and hydrologic function promote resilience and reduce the potential for disturbance and damage.

The Wildlife Society with the Inkley et al. (2004) recommended several actions to help wildlife adapt to climate change and its potential effects on wildlife. These include: (1) managing for diverse conditions; (2) reducing nonclimate stressors on ecosystems; (3) reducing the risk of uncharacteristic high-intensity fires; (4) conducting medium and long-range planning; (5) ensuring ecosystem processes; and (6) employing monitoring and adaptive management, as well as controlling for invasive plant species. Finally, it will be important to set priorities by appropriately balancing sensitive and vulnerable species and systems with those that are resistant and resilient (Glick and Edelson 2011).

On the Kaibab NF, existing collaborations between the AGFD and Coconino County generally encourage the protection of open lands and the preservation of the land's natural character within local and regional contexts. These collaborative strategies should decrease the potential for future land fragmentation while improving the overall integrity of the landscape. This should also

provide for more resilience with regard to climate change for those wildlife species that may need to adjust migration routes, foraging corridors, or breeding grounds.

Planning Tools

To assist each national forest with better integration of climate change considerations into project-level planning, the Agency is actively engaged in developing user-friendly planning tools, assessments, and Web-based resources. For example, resource managers are encouraged to use rapid assessment tools, such as the Climate Project Screening Tool (CPST) (Morelli et al. 2012). The CPST is a decision-support tool that provides a direct link between best available science and management actions. Further, it is a process-oriented activity that integrates climate change trends for a particular region, with project design considerations for various resource areas. Composed of a series of climate change related questions relevant to the area of interest (developed collaboratively by scientists and interdisciplinary team specialists), the final outcome of the exercise for a particular project is a decision of proceed, modify, or cancel, given how well it meets the climate change considerations in the preceding questions, e.g., does it still make sense to do the project? Finally, this tool helps managers set priorities by considering the effects of different projects with regard to climate change, and helping to reduce management uncertainty.

Specifically for wildlife, the Forest Service Rocky Mountain Research Station has developed a System for Assessing Vulnerability of Species (SAVS). This system helps wildlife specialists quantify the relative impact of expected climate change effects for terrestrial vertebrate species. This decision-support tool uses criteria related to expected response or vulnerability of species in a questionnaire to provide a framework for assessing vulnerability to climate change. The questionnaire focuses on habitat, physiology, phenology, and biotic interactions. This tool helps to inform management by identifying specific traits and issues related to vulnerabilities of individual species. Additional information on this application can be found at: http://www.fs.fed.us/rm/grassland-shrubland-desert/products/species-vulnerability/

Finally, a comprehensive Web site has been launched that serves as a clearinghouse for climate change related information. Organized by resource area, this is a "one-stop shopping" site that provides scientists and managers with the information and resources needed to incorporate the most up-to-date climate change considerations into both near and long-term planning initiatives: http://www.fs.fed.us/ccrc/.

Summary

By managing for resistant and resilient ecosystems, promoting landscape connectivity, and implementing concepts of adaptive management, land and resource management plans can provide the framework for responding to new information and changing conditions related to climate change that have the potential to increase impacts to ecosystem risks. The revised Kaibab National Forest Land and Resource Management Plan should provide clear management direction and include the necessary monitoring and mechanisms that would facilitate adaptation over time.

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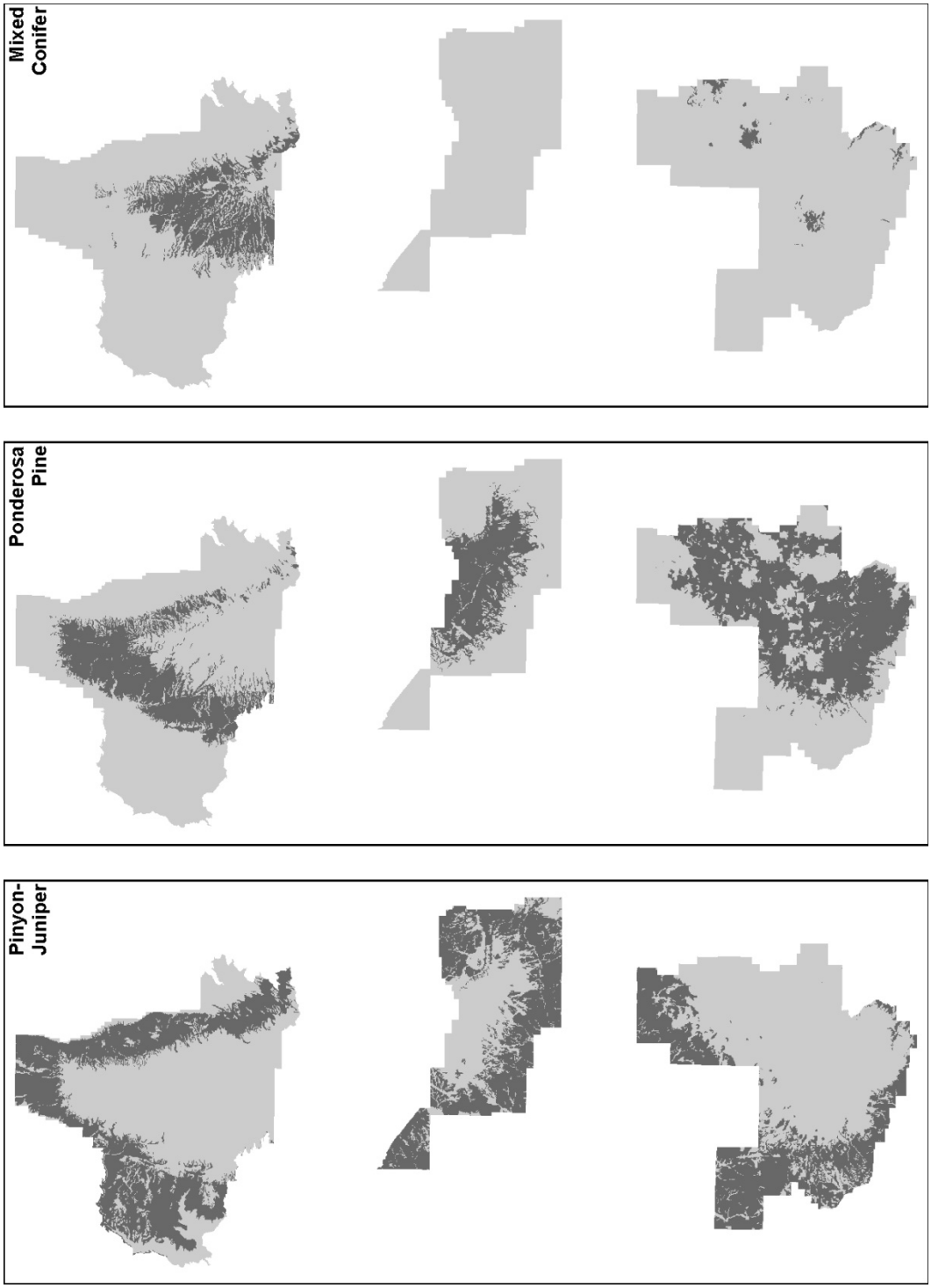
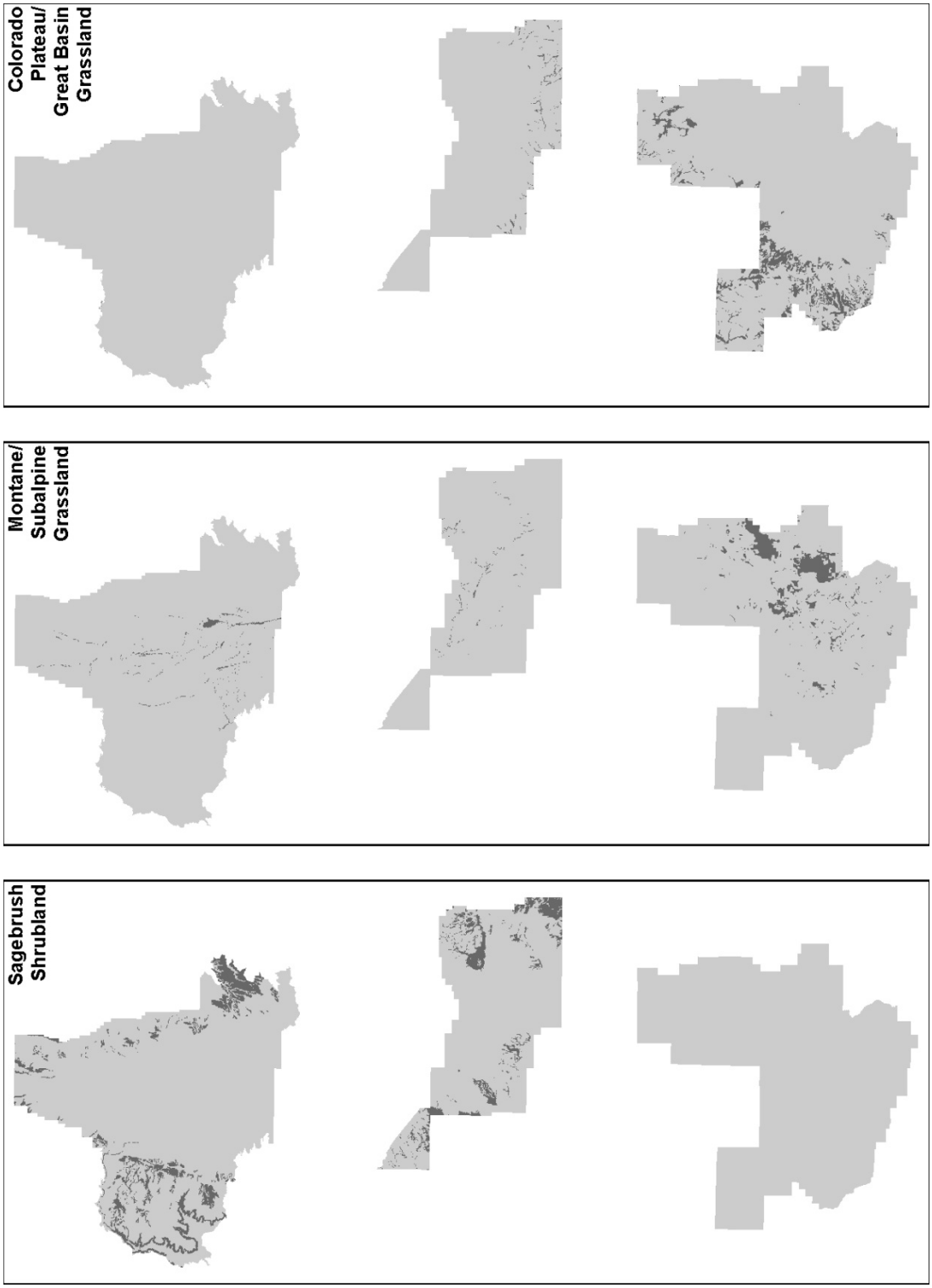
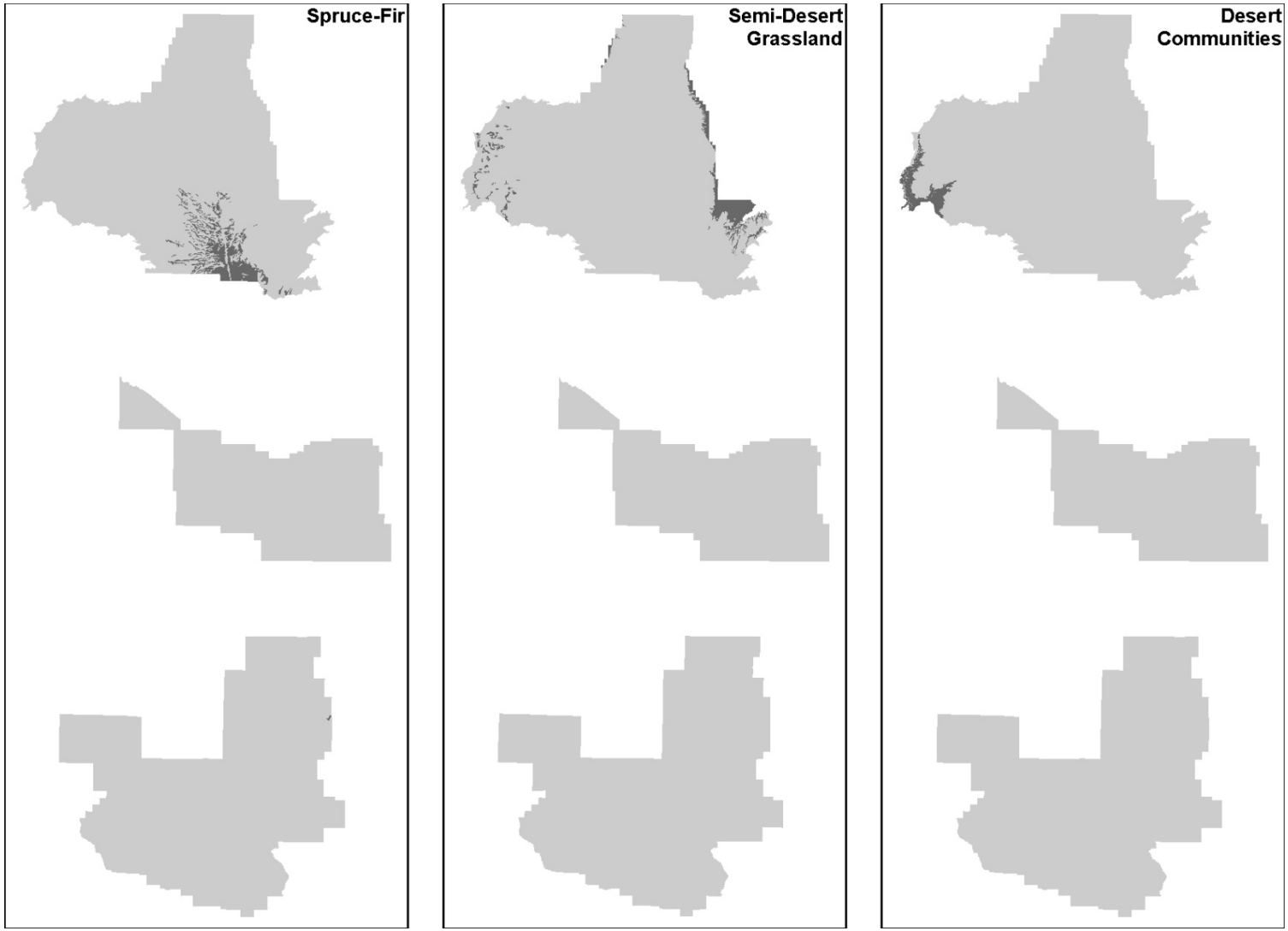
Appendix E. Kaibab National Forest Major Potential Natural Vegetation Types



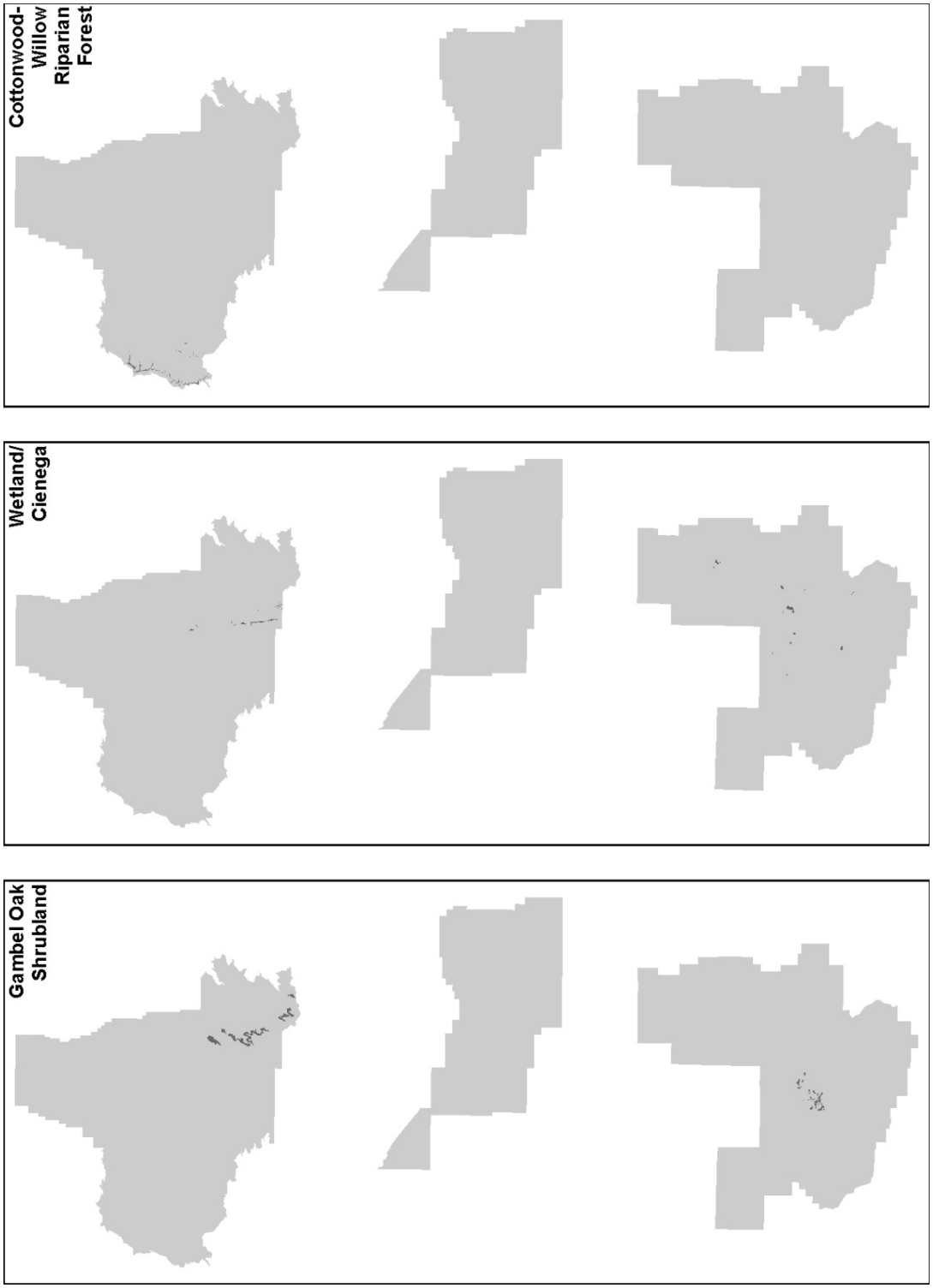
Kaibab National Forest potential natural vegetation types (dark areas)



Kaibab National Forest potential natural vegetation types (dark areas)



Kaibab National Forest potential natural vegetation types (dark areas)



Kaibab National Forest potential natural vegetation types (dark areas)

Appendix F. Electronic Sites and Utility Corridors

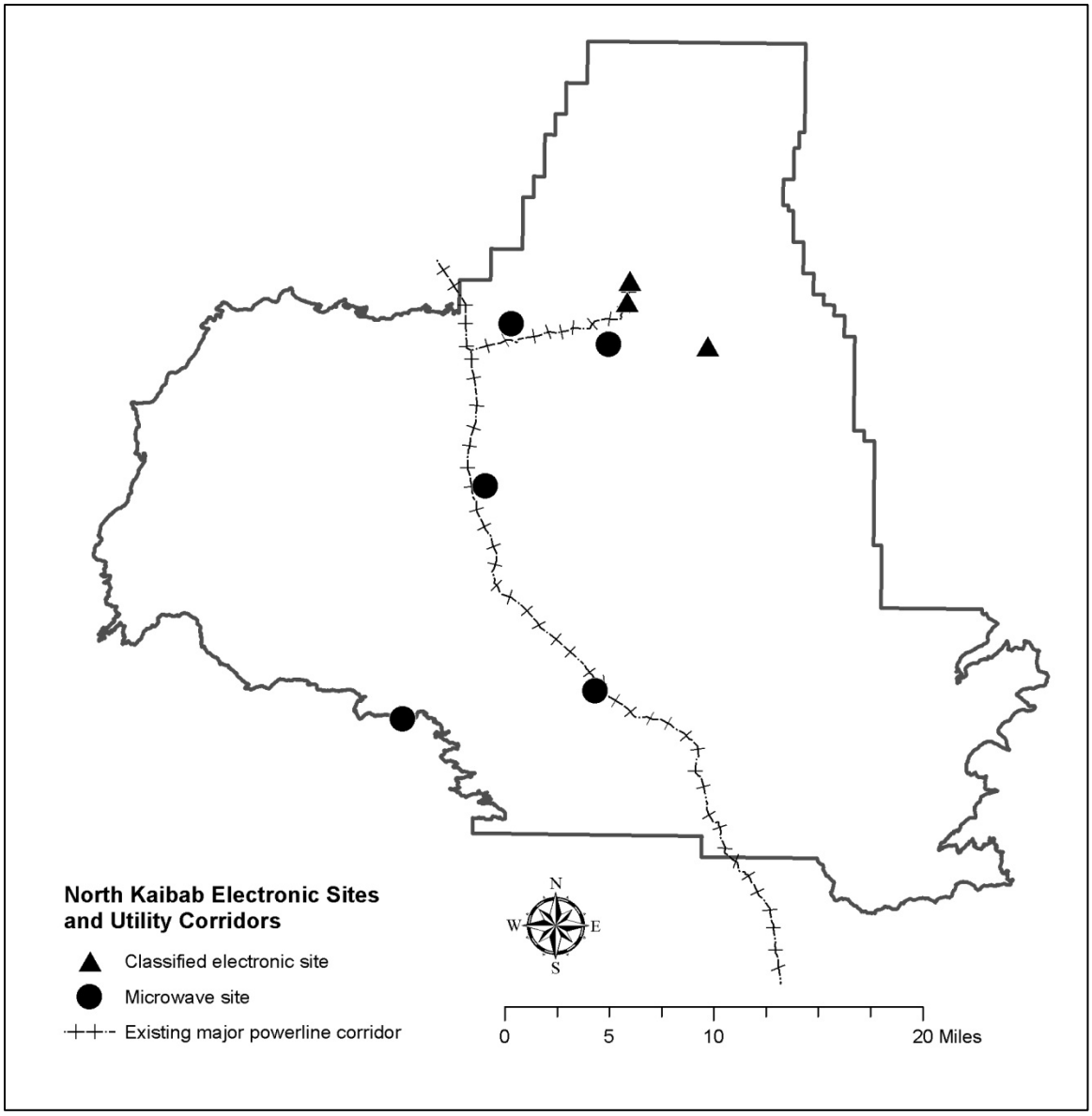


Figure F1. Electronic sites and utility corridors on the North Kaibab Ranger District

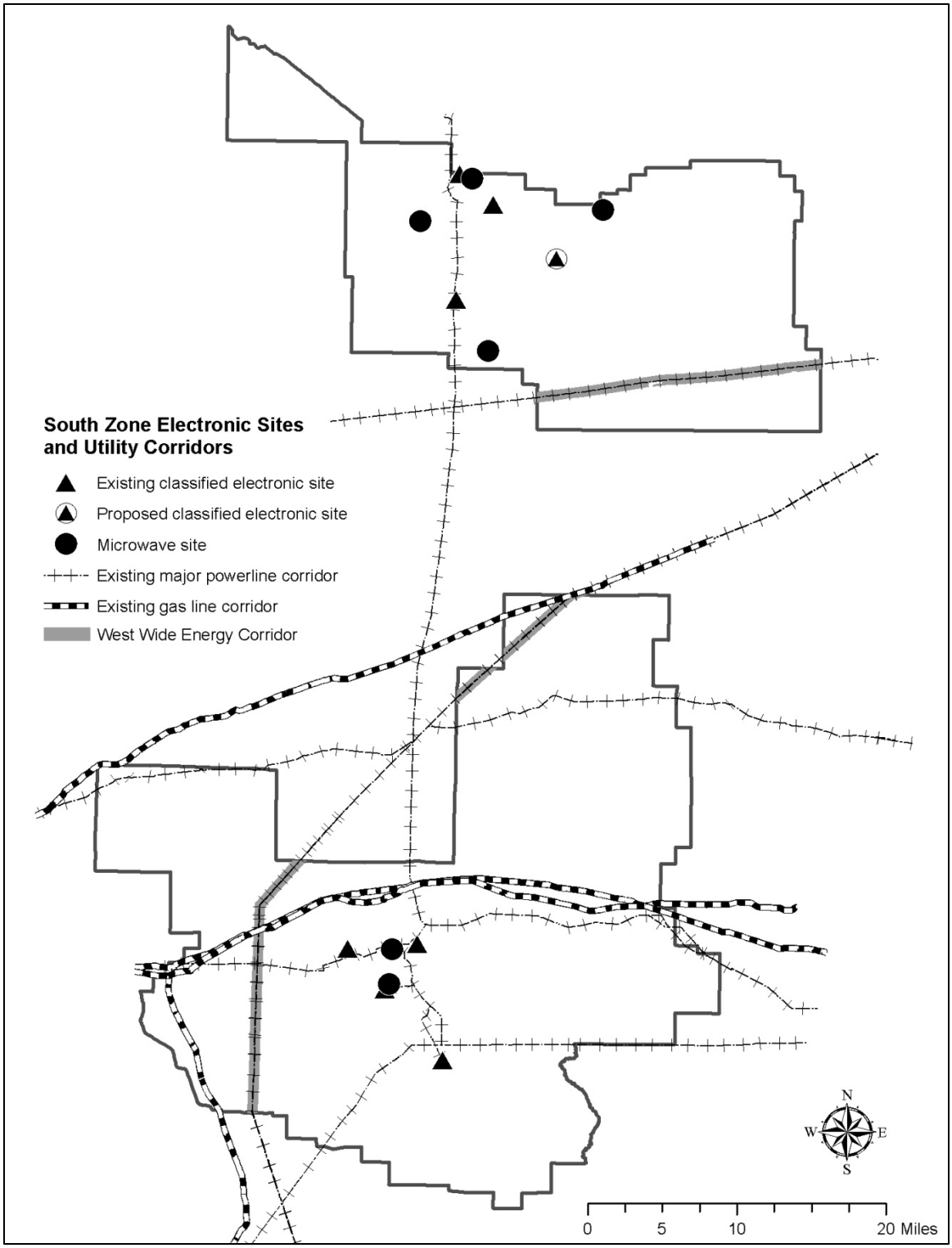


Figure F2. Electronic sites and utility corridors on the Williams and Tusayan ranger districts