

Attachments to Burnt Corral Vegetation Management Plan Proposed Action

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Attachment A. Design Features & Specifications (Mitigation Measures & Best Management Practices)

The following is a listing of Design Features and Specifications, including Mitigation Measures and Best Management Practices (BMPs) by resource area (Project Record #). These Design Features and Specifications include watershed conservation practices and relevant Forest Plan standards and guidelines, as well as other applicable requirements. The design features presented below may change based on actual data and field verification for specific vegetation and soil types; based on the environmental analysis performed for the project the revised design features will be included in the Final environmental analysis report, Monitoring requirements may also be added.

Silviculture

Silvicultural prescriptions and design criteria would follow *Kaibab NF Land Management Plan* Standards and Guidelines.

- Opening size would follow Forest Plan guidelines for up to 4 acres with maximum width of 200 feet.
- Protection of ponderosa pine plantations established after salvage timber harvesting following the Bridger Knoll fire of 1996. These areas are designated on the map and measures would be written into the burn plans and prescribed fire prescriptions to protect and keep alive during firing operations.
- Vegetation treatments with mechanical thinning on steep slopes, and sensitive soils with the option to handpile where necessary, or masticate where appropriate, or lop and scatter where applicable.
- Within mixed conifer areas of the forest, vegetation treatments would adopt stocking guidelines for basal area and Stand Density Index from recommendations for Mexican Spotted Owl recovery plan on the Kaibab NF.

Range

Each protocol on this list is formed from the 2005 *Final Environmental Impact Statement for Integrated Treatment of Noxious or Invasive Weeds for the Coconino, Kaibab, and Prescott National Forests*; Appendix B-Design Features, Best Management Practices, and Required Protection Measures.

- Conducting a pre-treatment inventory inside the project area. Areas to be inventoried will be prioritized in chronological order of anticipated activity timing before the project implementation begins. Areas likely to receive higher traffic like staging areas and along roads will be monitored first and random sampling of areas planned for treatment will follow in a timely manner. Areas where high infestations of aggressive invasive species are found, planned activities in that area will be delayed until the species is controlled.
- Prioritizing treatment of invasive species found during inventory. Invasive species found during inventory will be lumped together with current known infestations and treated using the most efficient means possible and in accordance with the Coconino, Kaibab, and Prescott ROD for Noxious and Invasive Weeds (2005). Once the invasive species is controlled, planned activity can begin.
- Continuation of monitoring during treatment. During project activity treatments, monitoring will be ongoing for additional species undetected during initial inventory and ensuring compliance. In the

event that a new population is detected, the activity that site will be stopped until invasive species is controlled.

- Minimize soil disturbance to the extent practical, consistent with project objectives. This includes the design and need of slash piles, utilizing existing roads where applicable to decrease the need for new skid trails and fire lines.
- Washing equipment and vehicles related to activities prior to entering project area. Contracting officer will be responsible for ensuring this occurs on all equipment tied to a contract. The district will also require this policy for any vehicles and equipment used on project that came from off the district. Equipment and vehicles will also be washed before leaving the district at a pre-determined “clean location”.
- Ensuring weed free gravel and other materials sources. Providers of gravel and other materials used will have the source of material inspected prior to importing into the project area. If deemed necessary, material will be staged at pre-determined location for additional monitoring.
- Optimize prescribed burning for appropriate timing. Burning will be conducted during seasons of the year that promotes lower fire intensities and hinders possible weed infestation. Burning in dry years will also be avoided for improved native plant response.
- Utilizing Certified Weed Free Seed Sources. In the event that an area needs to be seeded post treatment, seed purchased will be from a reputable dealer that can provide official weed free certification for each species utilized. Seed mix will consist only of native species and/or certified sterile annuals and require approval of District Range Conservationist or Forest Botanist. In the event that local seed harvesting is available and certified as “weed free”, that source will be utilized.
- Monitor after restoration treatment activity is completed. Random sampling will occur in areas that have been treated for at least two years after completion to monitor for invasive species that may have been introduced or spread.

Soil and Watershed

To meet the objectives of the Federal Water Pollution Control Act as amended in 1987, the USDA Forest Service, Southwestern Region in 1990 entered into an intergovernmental agreement with the State of Arizona, Department of Environmental Quality. It was agreed that the most practical and effective means of controlling non-point source pollution sources from forest and rangelands was through the development of preventative land management practices generally referred to as Best Management Practices (BMP's), and to ensure the control of non-point source pollution through the implementation of BMP's. Each project is required to identify and implement site specific Best Management Practices designed to protect soil and water quality (Interagency Agreement, 1990). Unless monitoring proves contrary, implementation of the following BMP's constitutes complying with Arizona State and Federal Water Quality Standards for designated uses in downstream perennial waters.

Utilize applicable guidance from the *National Best Management Practices (BMPs) for Water Quality Management on National Forest System Lands*, Volume 1: National Core BMP Technical Guide (FS-990a); April 2012: The Forest Service National BMP Program is the agency's nonpoint source pollution control program for achieving and documenting water resource protection. The National BMP Program demonstrates the agency's commitment to land stewardship and protection of water quality consistent with the CWA, State regulations, and other requirements. The National BMP Program is not intended in any way to circumvent or interfere with State and tribal CWA programs, rather it is intended to support and assist the States and tribes in their efforts to ensure compliance on NFS lands.

The following BMP's are designed to minimize the impacts of timber harvest and fuel treatment activities to soil and water resources. They apply to all action alternatives:

- A. Use of USDA-FS, Southwester Region Terrestrial Ecosystem Survey of the Kaibab National Forest, (TES) Coconino County and Part of Yavapai County, Arizona (May 1991, as amended) Map in Timber Sale Design - Cutting units are designed in a manner that minimizes soil disturbances and facilitates BMP implementation. Obtain a TES map for location of site specific BMP's in specified TES map units.
- B. Use of Sale Area Maps for Designating Stream Courses for Water Quality Protection – Locations of designated stream courses and/or drainages, will be shown on the sale area map. Sink holes, meadows, springs seeps, and other surface waters (stock watering tanks) to be protected are also shown on sale area maps.
- C. Stream Course/Drainage Protection – Stream course and/or drainages to be protected are shown on the sale area map. Stream course and/or drainages are crossed perpendicularly only at designated crossings. Tractor skidding, decking of logs, fire lines, machine and hand piling of slash are not permitted within stream courses and/or drainages. Drainage features such as lead out ditches, water bars, etc., are not constructed in such a manner that surface runoff is permitted to enter a stream course and/or drainage.
- D. Activity generated fuels from timber harvest activities are removed from stream courses and/or drainages. Trees are to be felled outside the stream course and/or drainages. The timber sale administrator has the authority to approve skid trails and log landings outside stream courses and/or drainages.
- E. Log Landings – All log landing locations are approved in advance of logging activities by the Forest Service. Existing log landings will be utilized unless locations are deemed unacceptable by the Forest Service (drainage channels, steep slopes, etc). Log landings are not located in sink holes and meadows (TES map unit 9). Log landings will be located where a minimum of clearing or excavating is needed and at least 100 feet away from stream channels/drainages. Landings will be kept to the minimum size necessary to allow safe operations. Log landings are permitted within these map units if the area is less than 15percent slope and is large enough to facilitate a log landing and is accessible by an existing haul road.
- F. Erosion Control of Skid Trails, Landings, and Fire lines – All skid trails and fire lines will be water barred and reseeded with an erosion control native seed mix following completion of mechanized equipment operations. Lopping and scattering of slash can be substituted for water barring if the Purchaser and Forest Service agree. Skid trails and fire lines accessible from open roads will be blocked or disguised to discourage vehicle travel. Depressions such as ruts and berms are filled in or removed, restoring skid trails and fire lines to the natural grade of the slope where possible. A Forest Service approved erosion control seed mix will be applied at a rate of 4 pounds/acre on all skid trails, landings and fire lines. In addition, skid trails and fire lines located in sensitive soils mapping unites (according to TES and its associated maps) may utilize water bars constructed by hand where excessive slope prevents improper water bar construction by machine. Lopping and scattering of slash can be substituted for water barring in these areas if the Purchaser and Forest Service agree.
- G. Limit the Operating Season – The operation of equipment will be prohibited when soil conditions are such that accelerated soil erosion, excessive soil surface displacement, or excessive compaction would occur. Ground-based mechanical falling, skidding, decking, machine piling and other off-road ground based operations will be stopped in units where soil conditions are such that soil damage is likely. The Sale Administrator will consult with soil and watershed specialist if necessary.

Operations may occur outside the normal operating season (May 1 to November 15) when erosion control work is up to date and when the prohibitive soil conditions described above are not present. Guidelines for winter operations include reasonably dry conditions or a combination of frozen soil

and snow cover conditions sufficient to minimize or eliminate soil displacement, compaction, and ground cover disturbance will be required during winter logging operations. The objective is to minimize soil compaction and displacement (rutting, etc). This applies to soils in all TES map units.

- H. Soil Loss at Tolerance – Maintain acceptable effective ground cover levels to prevent soil loss from exceeding tolerable soil loss limits. Analyze effective vegetative ground cover to determine tolerable soil loss levels. Permit light to moderate ground disturbances (vegetative ground cover is disturbed, but not displaced or removed). The Sale Administrator has the authority to require skid trail designation prior to felling to limit ground disturbance. In those areas where severe disturbance has resulted in removal of vegetative ground cover, apply harvest slash, reseed or other erosion control measures to restore the disturbed area. This applies to all TES map units. BMP's C, D, E, F, and G apply to designated skid trails and log landings. BMP's N, O, and P apply to roads.
- I. Coarse Woody Debris – To maintain or improve long-term soil productivity, manage towards a minimum of 5 to 7 tons/acre of coarse woody debris. In TES map unit 624, manage towards a minimum of 8 to 16 tons/acre. Coarse woody debris is defined as material greater than 3 inches in diameter. Coarse woody debris should be scattered evenly across the soil surface and represent all size classes where possible. Unmerchantable or cull trees are to remain on site and not brought into landing or decking areas. In areas (TES map unit 293 in the Marble Canyon Watershed, TES map unit 620 in the Kanab Creek Watershed and TES map Unit 624) where coarse woody debris is deficient, lop and scatter slash to meet this guideline. Also, lop and scatter slash in TES map unit 9. This BMP does not apply to urban interface areas or fuel breaks.
- J. Machine Piling of Slash – Machine pile activity generated fuels at log landings and where fuel loading exceeds target levels for Coarse Woody Debris. All machine piling will be accomplished using a Forest Service approved brush rake in order to minimize displacement of soil and rock. Machine pile when soils are frozen or dry. Machine piling of slash is not permitted in certain sensitive soils areas as determined by the TES. Lop and scatter activity generated fuels in TES map unit 9. A Forest Service approved erosion control seed mix is applied at a rate of 4 pounds/acre on all landings. Reseed with native grass species.
- K. Hand Piling of Slash – Do not hand pile slash in designated stream courses or drainages, springs, seeps, or other designated protected areas. Within certain sensitive soils areas as determined by the TES vegetation will be lopped and scattered. Hand piling and burning of PCT slash can occur in Map Unit 9 only in those locations where resulting fuel loads exceed 10 tons per acre. Where appropriate, reseed with native grass species.
- L. Broadcast Burns – Conduct broadcast burns when moisture and temperature conditions are suitable for burning that reduces fuels without totally consuming forest duff, completely removing effective vegetative ground cover and exposing bare soil. Do not allow complete consumption of heavy concentrated fuels where the potential exist for heat to expose and damage soils. Maintain acceptable effective ground cover levels to prevent soil loss from exceeding tolerable soil loss limits. Table 3 in this report presents effective vegetative ground cover (expressed as a percent) at tolerable soil loss levels. Reseed severely burned areas with a Forest Service approved erosion control seed mix applied at a rate of 4 pounds/acre. Reseed with native grass species. No broadcast burning is permitted in TES map unit 9 due to unsatisfactory soil conditions.
- M. Road Maintenance – Existing and roads to be opened for administrative use are maintained throughout the life of the timber sale. Ensure that existing drainage structures (rolling dips, culverts, rock crossings, etc.) are functioning correctly. Lead out ditches are maintained in a manner that does not allow sediment laden runoff to enter stream courses and/or drainages. Road debris and spoil material as a result of road maintenance activities is not permitted to enter any stream courses

and/or drainage. Roads are to receive maintenance prior to winter shut down of logging operations. Forest Service will determine if additional or new drainage structures are needed.

- N. Traffic Control During Wet Periods – To prevent road damage, the use of existing and temporary roads is not permitted during wet periods. Restrictions are decided by the timber sale administrator.
- O. Administrative Roads to Be Closed – Roads are lightly scarified and reseeded with native grasses species effective in controlling surface erosion. Road berms are removed and ruts are filled in. Existing drainage control structures are cleaned, maintained and are working effectively. If possible, camouflage or block the road entrance to disguise the road closure.
- P. Servicing and Refueling Equipment – During servicing and refueling of equipment, pollutants from logging and road maintenance equipment are not permitted to enter stream courses or drainages. Select servicing areas well away from surface waters, seeps, springs, stream courses and drainages. The timber sale administrator will designate the location, size and allowable uses of service and refueling areas.
- Q. Conduct Implementation and Effectiveness Monitoring – Refer to the soil and water monitoring plan.

Soil and Water Monitoring Plan

The intergovernmental agreement currently in effect between the Arizona Department of Environmental Quality and the USDA Forest Service, Southwestern Region requires implementation and effectiveness monitoring of Best Management Practices. The following monitoring schedule and methodology will meet this requirement:

- Phase 1 – During Timber Sale Activities
The timber sale administrator will monitor the implementation of BMP's during timber harvesting activities. Notes taken by the timber sale administrator will be used to track any issues or problems with BMP implementation. The Forest Soil and Watershed Specialist will provide assistance as needed by the timber sale administrator to provide clarification of BMP's specified in the Environmental Assessment.
- Phase 2 – Timber Sale Closure
The timber sale administrator will verify that the timber sale purchaser has implemented all erosion control measures prior to the closure of the timber sale. Primary responsibility will be that of the timber sale administrator with assistance from the Forest Soil and Watershed Specialist if needed.
- Phase 3 – Broadcast and Pile Burning
The District Fire Management Officer will verify that all erosion control measures associated with all burning activities has been implemented. The Forest Soil and Watershed Specialist will be provided assistance, if needed.
- Phase 4 – Effectiveness Monitoring
Within the first 5 years following timber sale closure, BMP's are evaluated for effectiveness. Monitoring will concentrate on such items as erosion control measures for skid trails, log landing or decking areas, road maintenance and burned areas. Conduct a soil condition evaluation within cutting units. Focus on such items as vegetative ground cover, coarse woody debris, erosion, soil compaction and displacement. All monitoring results are documented. Primary responsibility is with the District Ranger and the Forest Soil and Watershed Specialist.
- Phase 5 – Follow Up
Documented information obtained from monitoring is used to adjust BMP's as necessary, to improve implementation and effectiveness of BMP's. Information regarding monitoring results and

recommended changes to BMP's will be made available to the Arizona Department of Environmental Quality for review as specified in the Intergovernmental Agreement. Primary responsibility is with the District Ranger and the Forest Soil and Watershed Specialist

Cultural Resources

- In order to protect cultural resource sites, all sites have been identified and documented using cultural resource survey standards as per the North Kaibab Survey Strategy (Reid and Hanson 2006). The sites will be flagged for avoidance prior to project implementation. The standard survey procedures are designed to identify and document sites visible on the surface of the ground, so in the event that an undocumented site is unearthed during ground disturbing activities, implementation activities will cease and the North Zone archaeologist will be contacted to assess the remains and complete any legal consultation required.

Adverse effects to unevaluated cultural resource sites or sites eligible to the National Register of Historic Places will be avoided as standard practice. All design criteria will meet site protection standards in accordance with the provisions in the *First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities among the Arizona State Historic Preservation Officer and the Advisory Council on Historic Preservation and United States Department of Agriculture Forest Service Region 3* and associated appendices. Project-specific Design Criteria

- Fuels will be reduced atop fire-sensitive cultural resource sites. Fuel removal treatments will be determined based on the degree of fire sensitivity and fuel loading and may include manual thinning and low-intensity prescribed burning throughout the project area where appropriate.
- Erosion will be controlled at cultural resource sites across the project area. Treatments may include contour felling of trees, lopping and scattering of slash, hand-seeding with grasses, and application of mulch and placement of logs around sites through manual or mechanical means.
- In the event that an adverse effect cannot be avoided, mitigation measures will be designed in consultation with the Arizona State Historic Preservation Officer, the Advisory Council on Historic Preservation, and culturally affiliated tribes if applicable, following the procedures in the 36 CFR 800 regulations, in compliance with Section 106 of the National Historic Preservation Act.

Traditional and Cultural Uses

The forest will consult with tribes concerning project design and implementation. The forest will provide local tribes continued access to forest resources, and opportunities to engage in traditional practices

Fire and Fuels Activities

- A prescribed fire burn plan would be prepared for each prescribed fire treatment utilizing the interagency prescribed fire burn plan template and in accordance with silvicultural and range management prescriptions
- Broadcast burning operations would not typically occur within mechanical treatment units within the same year. The burning of slash piles would typically occur prior to broadcast

burning operations. However, broadcast burning within mechanical treatment units may occur within the same year , pending North Kaibab resource management staff review and District Ranger approval.

- Mechanical units would be evaluated annually to ensure that follow up prescribed burning does not create more mortality than stated in silvicultural prescription
- Grazing within post-fire treated areas should not be authorized until Forest service range staff confirm range readiness.
- Develop prescribed fire treatment objectives that maintain or restore desired conditions for: snags and green snags, downed logs, and per acre fuel loadings of coarse woody debris, including downed logs at the mid-scale level for each major vegetation communities found within the project area.
- All prescribed fire activity would be conducted consistent with wildlife restrictions (i.e. defined nesting-breeding seasonal restrictions)
- Ignite prescribed burns when fuel moistures are high enough to prevent frequent torching of larger overstory trees
- Implement pre-burn preparation measures to mitigate potential negative effects to trees specifically designated for protection (i.e. known NOGO Nest trees, Superior trees used for cone collection)
- Schedule burns that avoid weather conditions, which would impact smoke sensitive areas and create excessive smoke particulate emissions at critical smoke receptor sites.
- Prescribed fire burn objectives for prescribed fire treatments within the Bridger Knoll fire history area will ensure wildlife habitat objectives are addressed when appropriate, in cooperation with Arizona Game and Fish.
- Prescribed fire treatments within the mixed conifer vegetation type will utilize treatment prescriptions that are designed to reduce potential negative effects to the key structural elements of Mexican spotted owl habitat.
- Develop prescribed fire treatment objectives that maintain or restore desired conditions for: snags and green snags, downed logs, and per acre fuel loadings of coarse woody debris, including downed logs at the mid-scale level for each major vegetation communities found within the project area.
- Prescribed fire treatments within the mixed conifer vegetation type will utilize treatment prescriptions that are designed to reduce potential negative effects to the key structural elements of Mexican spotted owl habitat.

Recreation and Visuals

- Mark trees on side facing away from road on trees found within 200 ft of the road edge. Do the same on trails found within 50 ft of the trail edge.
- If "leave" trees are marked within 200 feet of any Forest Service system road or within 50 feet of any system trail, use a bark-colored paint mix to cover such marks no later than the end of the season that harvest occurs, and mark on the side facing away from the road or trail.
- Sign trails/trailheads to advise of vegetative or prescribed burning treatments, schedule, closures.
- Keep stump heights low (6 inches) within 50 ft. of trail edges.
- If sanitation cuts are used to reduce mistletoe, feather edges up to the treatment areas to avoid abrupt changes in tree densities.

- Rehabilitate skid trails, log decks, or other disturbed areas by restoring the original contours, fine grading, and seeding with native seed mix.
- Treat slash consecutively during commercial and non-commercial thinning.

Engineering and roads

- District engineer will establish a suitable road system to implement the vegetation management project.
- District engineer will open any closed roads for the project and re-close at project completion.
- Project should follow USDA – U.S. Forest Service, National Best Management Practices for Water Quality Management on National Forest System Lands. Volume 1: National Core BMP technical Guide (April 2012) as applicable.

Wildlife

Condor Conservation Measures

- Prior to the start of project activities, the North Kaibab Ranger District (NKR D) will contact personnel monitoring condor locations and movement to determine the locations and status of condors in or near the project area.
- All workers at the project site will be advised of the possibility of the occurrence of California condors in the project area.
- All workers at the project site will be instructed to avoid interaction with condors and to immediately contact the appropriate NKR D or Peregrine Fund personnel if condor(s) occur at the project area. To avoid injury both to condors and personnel, project personnel will not haze condors.
- If a condor occurs at a project site, only permitted personnel will employ appropriate techniques to cause the condor to leave the site. “Permitted” means those with the necessary federal and state permits.
- Any project activity that may cause imminent harm to condors will temporarily cease until permitted personnel can assess the situation and determine the correct course of action. It may be necessary to postpone the activity until condors leave the area or are hazed by permitted personnel.
- The project area will be kept clean (e.g., trash disposed of, tools and materials picked up) in order to minimize the possibility of condors accessing inappropriate materials.
- To prevent water contamination and potential condor poisoning, a hazardous material (including vehicle fluids) leakage and spill plan will be developed and implemented. The plan will include provisions for immediate clean-up of any hazardous substance, and will outline how each hazardous substance will be treated in case of leakage or spill. The plan will be reviewed by the district biologist to ensure condors are adequately addressed.
- If condors consistently occur at the project area, then additional conservation measures may be necessary. NKR D will report consistent condor occurrence at the project area to the Fish and Wildlife Service (FWS) in a timely manner, and will facilitate any necessary consideration of additional measures by NKR D and the FWS.
- If condor nesting activity is known within one mile of the project area, then loud activities will be restricted to outside of the active nesting season. The active nesting season is February 1-September 30. Those dates may be modified based on the most current information regarding condor nesting and consultation with the district biologist and the Fish and Wildlife Service. NKR D will report such occurrences to the FWS in a timely manner, and will facilitate any necessary consideration of additional measures by NKR D and FWS.

- Smoke from project activities will be prevented from negatively affecting condor breeding. A given project fire activity will be designed and managed to prevent significant amounts of smoke, or smoke that will remain in place for an extended period of time, or chronic smoke events, from occurring in area(s) where condors are attempting to breed.

Northern goshawks

- The Kaibab National Forest Plan will be followed to protect the species, its habitat and its associated prey species.
- Limit human activities within ¼ mile of an active nest site during the breeding season so that goshawk reproductive success is not affected by human activities. The breeding season extends from March 1 through September 30.
- In northern goshawk nest areas, tree-groups may be thinned from below; Promote varied, irregular spacing between trees.

Attachment B. Relevant selections from the Kaibab National Forest Plan

The purpose of this section is to provide a ready reference to the review of the proposed action. Each resource area will perform in-depth analysis during NEPA and additional sections of the Forest Plan identified as relevant. Full plan is available at http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3791580.pdf

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 18 inches *diameter at breast height* (d.b.h.) or greater average 1 to 2 snags 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.¹

Management Approach

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.

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.

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.

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 and 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", and relevant major vegetation communities.

Management Approach

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 *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 would be significantly impaired.

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.

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 Management

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

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, 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 currently include the California condor, Mexican spotted owl, Apache trout (*Oncorhynchus apache*), and Fickeisen Plains cactus (*Pediocactus peeblesianus* var. *fickeiseniae*) (proposed). Region 3 Sensitive Species² 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.

² 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

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.

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

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 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 one 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

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 and updated with new species, information, and locations as they become available.

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.

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.

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.

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.

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.

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.

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.

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 Aware¹⁴, Animal Inn¹⁵, 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 Trail¹⁶ 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.

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.

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.

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.

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.

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.

Management Approach for Natural Waters

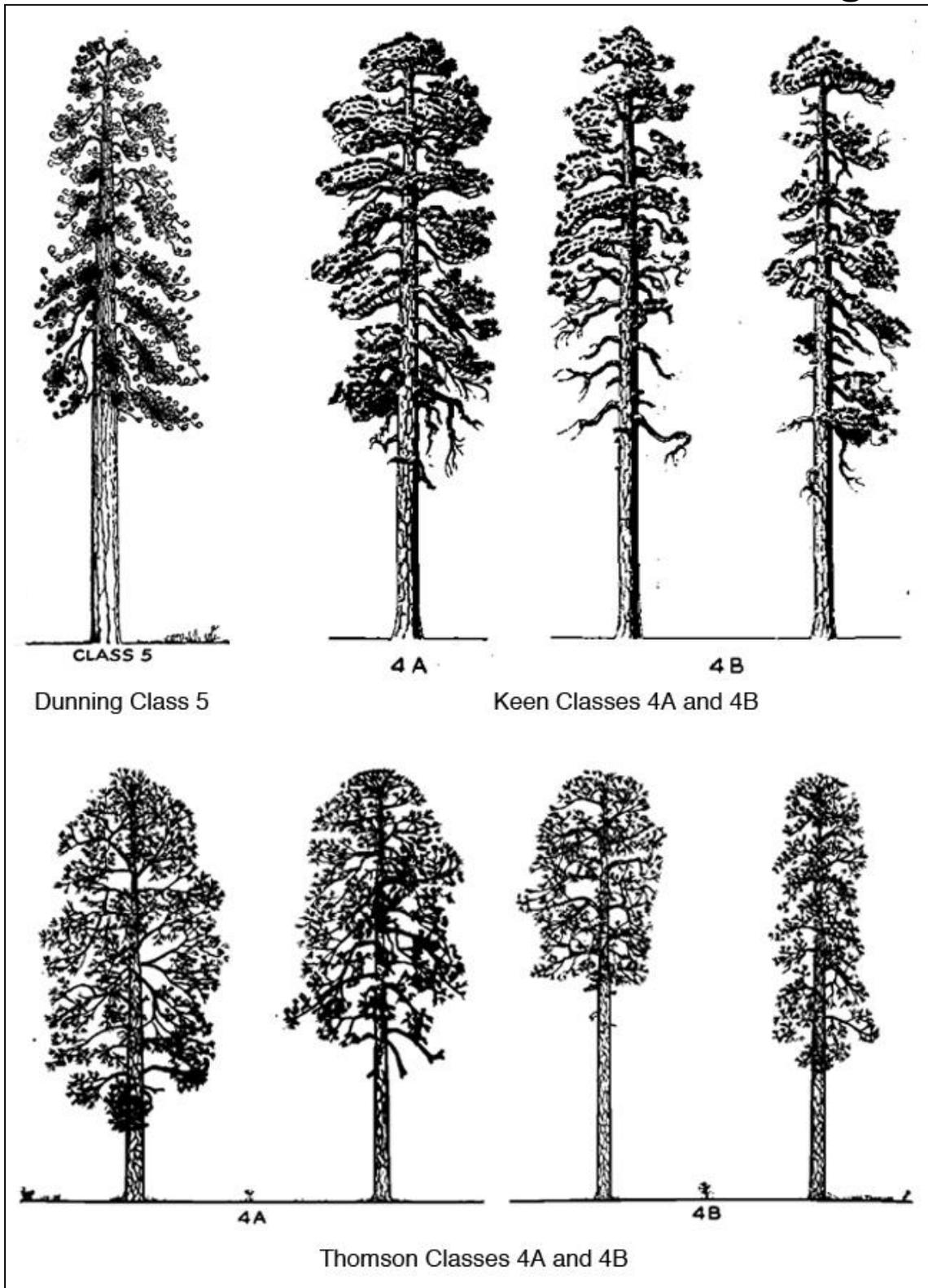
Due to the limited information available, Kaibab NF efforts and emphasis are placed on improving knowledge on the distribution of water resources and aquatic or wetland biota, resource protection, and rehabilitation of springs, including groundwater flow and geochemical analyses. Potential management 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 enclosures 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.

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

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Appendix D. Kaibab National Forest’s Climate Change Approach for Plan Revision

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.