Appendix D – Selected Alternative Implementation Plan with Errata and Objection Resolution Modifications

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Introduction

The environmental impact statement (EIS) describes the purpose and need, alternatives and the effects of managing the 4FRI project area. This implementation plan is designed to be integral to the selected alternative and record of decision (ROD). The plan has been updated to add more direction related to grazing, treatments in Mexican spotted owl protected activity centers, goshawk survey requirements and wildlife corridors.

The implementation plan is designed to be consistent with the Coconino NF and Kaibab NF forest plans and with Collaborative Forest Landscape Restoration Act (CFLRA). The Collaborative Forest Landscape Restoration Act requires that restoration treatments maintain or contribute to the development of old growth components, maximizes the retention of large trees, focuses on small diameter tree thinning, does not allow for the establishment of permanent roads, and requires decommissioning of all temporary roads built for treatment purposes.

The process described in this appendix describes the linkage from the EIS to the project specific work without the need for additional NEPA analysis. It must be considered in conjunction with appendix C that provides the design criteria, best management practices, and mitigation measures. Table D 1 to table D 4 are checklists designed to ensure compliance with the analysis, decision, and other requirements. Essentially, if the quantity of treatments in table D 1 and table D 2 by resource unit are within the bounds of the treatments analyzed in chapter 3 of the EIS and the specialist's reports, then the program of work is considered to be consistent with the effects analysis.

Table D 3 and table D 4 show the compliance evaluation and documentation requirements to also demonstrate this compliance. Sections A through E provide direction that will be used by implementation personnel to ensure that implementation meets the purpose and need and forest plan standards and guidelines. It is the foundation for the formal silvicultural prescriptions. The silvicultural prescriptions will document the desired conditions presented in the analysis, incorporate design features and mitigation (appendix C), and provide the course of action needed to move toward those desired conditions.

Description of Plan Components

Table D 1: Annual Implementation Checklist. The checklist is designed to track compliance with the NEPA decision and ensure activities are consistent and compliant with the analysis and decision (correct location, appropriate number of acres by treatment type). The checklist is designed to be used by the implementation team leader. Sources of data to populate row three are found in chapter 3 and the specialists reports.

Table D 2: Planned Acres by Treatment Type and Restoration Unit. The checklist is designed to facilitate accomplishment reporting. The checklist is designed to be used (at a minimum) by the implementation team leader and forest program managers. Sources of data to populate row three are found in chapter 3 and the specialists reports.

Table D 3: National Environmental Policy Act (NEPA), National Forest Management Act (NFMA), Endangered Species Act (ESA), and Collaborative Forest Landscape Restoration Act (**CFLRA) Compliance Evaluation.** The checklist is designed to ensure resource surveys are completed as required by the forest plan, policy, U.S. Fish and Wildlife Service biological opinion, the Collaborative Forest Landscape Restoration Act, or other requirements. The checklist

also ensures that the site-specific treatments are compliant with the NEPA analysis and decision. The checklist is designed to be used by the resource specialists who comprise the implementation team and by the Agency's (delegated) approving official.

Table D 4: **Supporting Documentation**. This checklist is designed to ensure required plans and surveys are tracked annually and are readily accessible to the implementation team and approving official. It will be used in combination with appendix E that shows the adaptive management strategy.

Section A: This section includes existing forest plan management direction, desired conditions, and treatment specific silvicultural design. It is designed to be used by the project silviculturist and implementation team. As a result of the objection resolution process, section A has been updated to clarify 46,090 acres will be monitored using both ground-based and remote sensing monitoring to ensure and compare consistency with expected canopy cover levels. Appendix D has also been updated to include language that will retain VSS 5 and 6 tree groups within the 2,750 acres designated for corridor treatments outlined in Rosenstock and Gist (2014). The implementation checklist in Section A has also been updated to include grazing-related monitoring questions. The checklist has been updated to include Mexican spotted owl monitoring questions.

Section B: This section is a decision matrix to be used by the project silviculturist and implementation team to facilitate establishing tree groups, interspace, and regeneration openings as appropriate for each individual treatment.

Section C: This section provides old tree descriptions, illustrations, and guidance used to implement the old tree implementation plan.

Section D: This section includes guidance and the "Modified Large Tree Implementation Plan". The guidance is designed to be reviewed by the project's silviculturist during development of prescriptions and during implementation.

Section E: This section describes the relationship between treatment intensity, tree group density, and overall average density. It includes density management and stocking guidelines. It is designed to be used by the project silviculturist (in the design of prescriptions) and implementation team.

Section F: This section includes a map and stand list for the stands identified as having a preponderance of large trees (46,090 acres) with the subset occurring within grassland corridors requiring coordination with AZGFD at implementation (up to 2,750 acres).

Table D 1. Annual implementation checklist

Implementation Checklist	Details				
Project name:					
Project location (legal):					
Summary of activities proposed in this phase:					
Is the project located within the project boundary displayed in the FEIS/ROD?					
Identify the restoration unit (RU) in which the project phase is located based on the FEIS/ROD.	**RU1**	**RU3**	**RU4**	**RU5**	**RU6**
(1) How many acres have been treated by RU since the ROD was signed?					
(2) How many remaining acres are available for treatment by RU over the lifetime of the decision? (1–2)					
(3) How total many acres will this project (or task order) treat by RU?					
(4) Are the acres to be treated by RU less than remaining acres available for treatment? (3–4)					
Are acres proposed for treatment by RU within the limits approved by the decision?	**Yes_____ No_____**				

Table D 2. Planned acres by treatment type and restoration unit (RU)

Acre/Miles by Treatment Type to be Implemented in this Phase	RU1	RU3	RU4	RU5	RU6
Aspen					
Prescribed Fire Only					
ADGF Research					
Grassland Restoration					
Grassland Mechanical					
Intermediate Thin (IT) 10 (10 to 25% interspace)					
Intermediate Thin (IT) 25 (25 to 40% interspace)					
Intermediate Thin (IT) 40 (40 to 55% interspace)					
MSO Threshold					
MSO Target					
MSO Restricted					
MSO PAC					
MSO PAC Grassland Mechanical					
Pine-sage					
Savanna (70 to 90% interspace)					
Stand Improvement (SI) 10 (10 to 25% interspace)					
Stand Improvement (SI) 25 (25 to 40% interspace)					
Stand Improvement (SI) 40 (40 to 55% interspace)					
Uneven-aged (UEA) 10 (10 to 25% interspace)					
Uneven-aged (UEA) 25 (25 to 40% interspace)					

Acre/Miles by Treatment Type to be Implemented in this Phase		**RU1**	**RU3**	**RU4**	**RU5**	**RU6**
Uneven-aged (UEA) 40 (40 to 55% interspace)						
Wildland-Urban Interface (WUI) Pinyon-juniper						
Wildland-Urban Interface (WUI) 55						
Pile Burning						
Broadcast Burning						
Jackpot Burning						
Fire Line Construction						
Existing System and Unauthorized Road Decommission						
Temporary Road Construction						
Temporary Road Decommission as required by CFLRA						
Road Reconstruction/Relocation						
Springs	Remove Trees to Pre-settlement Condition					
	Remove Noxious Weeds					
	Prescribed Fire					
	Protective Measures					
Ephemeral Channels	Reestablish Drainage, Slopes, Vegetation					
	Site Protection					
	Remove or Rehab Stock Tanks					
	Other					
Construct Protective Fencing: Springs/Aspen						
Are acres proposed for treatments in this phase within the limits authorized in the decision?		**Yes_____ No_____**				

Table D 3. NEPA, NFMA, ESA, CFLR Act compliance evaluation

Compliance Evaluation	Yes	No	N/A
Is the project within the maximum treatment acres identified in the NEPA decision?			
Is treatment design consistent with desired conditions, design criteria, and mitigation? Does range readiness support the use of fire?			
Are wildlife and botanical surveys, if necessary, complete? Is the action consistent with the FWS biological opinion dated_____?			
Are heritage surveys complete? Is the action consistent with the letter of concurrence form the AZ SHPO dated_____?			
Have contacts with tribal representatives been made?			
Are rights-of-way and land line locations in place (if applicable)?			
Do treatments fully maintain or contribute toward the restoration of old growth stands as required by CFLRA and as consistent with the Old Tree Implementation Plan (section C)			
For PACs analyzed for mechanical thinning treatments, has occupancy been determined?			
Of the occupied PACs, was the selection of mechanical thinning treatment and reference PACs coordinated with the FWS?			
Are the occupied PACs selected for mechanical thinning treatments those with the greatest number of 9" treatment stands?			
Have the occupied PACs selected for mechanical thinning treatment been surveyed for occupancy and reproduction in both of the previous 2 years?			
Have the occupied PACs selected for mechanical thinning treatment been marked by hand in coordination with the FWS?			
Have the occupied PACs selected for mechanical thinning treatment had a completed pre-treatment vegetation survey?			
For PACs analyzed for burn-only treatments, has occupancy been determined?			
Of the occupied PACs, was the selection of burn-only treatment and reference PACs coordinated with the FWS?			
Have the occupied PACs selected for burn-only treatment been surveyed for occupancy and reproduction in both of the previous 2 years?			
Have the occupied PACs selected for burn-only treatment had a completed pre-treatment vegetation survey?			
For unoccupied PACs selected for mechanical thinning treatment, have they been verified to be unoccupied for 3 consecutive years?			
Have the unoccupied PACS selected for mechanical treatment been marked by hand in coordination with the FWS?			
Do treatments maximize the retention of large trees as required by CFLRA and as consistent with the Large Tree Implementation Plan (section D)?			
Has the monitoring and adaptive management plan been evaluated to document compliance with law, regulation, policy, and forest plans?			
Have additional implementation and effectiveness monitoring needs been identified?			
As required by CFLR Act, is multiparty monitoring underway?			
As required by CFLRA, are no new permanent roads required and has the decommissioning plan been followed?			
Are adaptive management actions being proposed? If so, clearly analyzed and covered by the decision made?			
Has the administrator checklist been completed and signed by the appropriate resource specialists?			

Compliance Evaluation	Yes	No	N/A
Is the treatment (burn) plan completed and signed? • Objectives have been developed in interdisciplinary manner and are clearly delineated? • Objectives are consistent with management direction? • Objectives match those described for RU in NEPA analysis? Complexity rating_____			
Do conditions match those described in NEPA analysis? Examples where conditions have changed: New listed species in project area; New invasive species in project area; Change in regulations Burn/treatment plan doesn't allow implementing design criteria			
Have issues identified in the NEPA analysis been reviewed?			
Has a post-implementation review been completed (may be filled out after approval)?			
Alternative C and E Only: Are treatments consistent with Large Tree Implementation Plan? (section D)			
Has there been any new or additional NEPA decisions that also need to be considered and is the proposal consistent with these decisions?			

Table D 4. Supporting documentation checklist

Document Name	Attached? Y/N
Silviculture Prescriptions	
Burn Plan (includes coordination with ADEQ)	
Transportation Safety Plan	
Wildlife Surveys	
Botany Surveys	
Archaeological Surveys	
Monitoring Results (including range readiness annual operating instructions)	
404/401 permit from the U.S. Army Corps of Engineers for channel restoration projects	
ADEQ Water Quality Certification	
Coordination with Tribes on individual task orders	

Project Resource Specialist Review

Based on my review, the project is consistent with the Coconino and Kaibab National Forests final environmental impact statement and record of decision (FEIS/ROD) implementing the Coconino and Kaibab NFs restoration project.

Name/Signature	Date	Resource Area
		Terrestrial and Aquatic Wildlife
		Botany
		Range
		Recreation
		Scenery
		Archaeology and Tribal Relations
		Fire
		Air Quality/Smoke
		Lands
		Soils and Hydrology
		Silviculture
		Planning/NEPA
		Transportation
		Public Affairs

Approving Official

I have reviewed the activities proposed for this year. Based on my review, the project is consistent with the Coconino and Kaibab National Forests final environmental impact statement and record of decision implementing the Coconino and Kaibab NFs restoration project.

_____ _____

Agency Approving Official, Title Date

ATTACHMENTS: (add to as necessary)

Section A – Management Direction, Desired Conditions, and Treatment Design

Mexican Spotted Owl Habitat

Kaibab NF and Coconino NF

The following vegetation management direction, desired conditions and mechanical treatment and burn for Mexican Spotted Owl habitat applies to alternatives B through E on the Kaibab National Forest and alternative C on the Coconino National Forest which has been designed to implement the current revised Mexican spotted owl Recovery Plan (USDI FWS 2012).

Restricted Other Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height, reduce litter/duff cover, and produce effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired Mexican spotted owl restricted other forest structure, tree densities, snag densities, and coarse woody debris levels.

Core Area

Vegetation Management Direction: Desired conditions should guide management within PACs (USDI FWS 2012). The intent of the core area is to define parts of the PAC that should receive maximum protection by limiting activities that have a high likelihood of disturbing owls or causing abandonment (primarily habitat alteration and certain forms of mechanical noise). The nesting and roosting core area should include habitat that resembles the structural and/or floristic characteristics of the nest and/or roost sites as much as possible (USDI FWS 2012). Vegetation management needs to be coordinated with US Fish and Wildlife Service.

Desired Conditions: Table C.2 of the Recovery Plan (USDI FWS 2012) lists guidance for desired conditions within PACs. The desired conditions include the following: Strive for a diversity of patch sizes with minimum contiguous patch size of 1 ha (2.5 ac) with larger patches near activity center; mix of sizes towards periphery. Forest type may dictate patch size (i.e., mixed conifer forests have larger and fewer patches than pine-oak forest). Strive for between patch heterogeneity; horizontal and vertical habitat heterogeneity within patches, including tree species composition. Patches are contiguous and consist of trees of all sizes, unevenly spaced, with interlocking crowns and high canopy cover; tree species diversity, especially with a mixture of hardwoods and shade-tolerant species; diverse composition of vigorous native herbaceous and shrub species; opening sizes between 0.04 - 1 ha (0.1 - 2.5 ac). Openings within a forest are different than natural meadows. Small canopy gaps within forested patches provide for prey habitat diversity. Openings should be small in nesting and roosting patches, may be larger in rest of PAC; and Minimum canopy cover of 40 percent in pine-oak and 60 percent in mixed conifer. Measure canopy cover within stands (USDI FWS 2012).

Protected Activity Center (PAC)

Vegetation Management Direction: Desired conditions should guide management within PACs (USDI FWS 2012). The intent of the core area is to define parts of the PAC that should receive maximum protection by limiting activities that have a high likelihood of disturbing owls or

causing abandonment (primarily habitat alteration and certain forms of mechanical noise). The nesting and roosting core area should include habitat that resembles the structural and/or floristic characteristics of the nest and/or roost sites as much as possible (USDI FWS 2012). Vegetation management needs to be coordinated with US Fish and Wildlife Service.

Desired Conditions: Table C.2 of the Recovery Plan (USDI FWS 2012) lists guidance for desired conditions within PACs. The desired conditions include the following: Strive for a diversity of patch sizes with minimum contiguous patch size of 1 ha (2.5 ac) with larger patches near activity center; mix of sizes towards periphery. Forest type may dictate patch size (i.e., mixed conifer forests have larger and fewer patches than pine-oak forest). Strive for between patch heterogeneity; Horizontal and vertical habitat heterogeneity within patches, including tree species composition. Patches are contiguous and consist of trees of all sizes, unevenly spaced, with interlocking crowns and high canopy cover; Tree species diversity, especially with a mixture of hardwoods and shade-tolerant species; Diverse composition of vigorous native herbaceous and shrub species; Opening sizes between 0.04 - 1 ha (0.1 - 2.5 ac). Openings within a forest are different than natural meadows. Small canopy gaps within forested patches provide for prey habitat diversity. Openings should be small in nesting and roosting patches, may be larger in rest of PAC; and minimum canopy cover of 40 percent in pine-oak and 60 percent in mixed conifer. Measure canopy cover within stands (USDI FWS 2012).

Site Specific Diameter Limits: Attachment 2 displays the location and sites and upper diameter limits for the proposed 18 mechanical treatment PACs. The treatments are designed to improve PAC habitat as well as reduce fire behavior.

Forested Recovery Habitat

Definition: Any stand within the Ponderosa pine series that meets the following criteria simultaneously: a. The stand is located in the Upper Gila Mountain ecosystem management unit; b. Habitat types that reflect Gambel oak or a Gambel oak phase of the habitat type; c. more than 10 percent of the stand basal area or 4.6 m2/ha (20 ft^2/ac) of basal area consists of Gambel oak over13 cm (5 in) in diameter at root collar.

For planning purposes in Forested Recovery Habitat, there are two types of stands with respect to desired nesting and roosting conditions: those that meet or exceed the conditions and those that do not. The overriding goal is to manage a specified portion of the landscape (see table D 5) as recovery nesting and roosting habitat. Thus, managers should identify and protect stands that meet or exceed nesting and roosting conditions and then assess whether or not these stands satisfy the area requirements in table D 5. If these stands are not sufficient to meet the area requirements in table D 5, managers should identify those stands in the planning area that come closest to meeting nesting and roosting conditions and manage those stands to develop nesting and roosting conditions as rapidly as reasonably possible to meet recommended percentages. Prescriptions may include thinning to promote growth of large trees. Stands that do not meet nesting and roosting conditions and are not designated for development of such can be managed to meet other resource objectives.

Forested Recovery Habitat Managed as Nesting and Roosting Habitat

Vegetation Management Direction: The following are excerpts from the current Mexican spotted owl Recovery Plan that display guidelines for forested recovery nesting and roosting habitat (formerly known in USDI FWS 1995 as threshold and target/threshold) as outlined on pages 267 and 268 of the plan.

Recovery nesting and roosting stands that currently meet nesting and roosting conditions: Treatments are allowed within Recovery Habitat stands identified as meeting nesting and roosting conditions, as long as stand conditions remain at or above the values given in table D 5. This approach allows for treatments to reduce fire risks, lessen insect or disease problems, maintain seral species, or meet other ecosystem objectives.

Recovery nesting and roosting stands that currently do not meet nesting and roosting conditions: Stands currently not meeting nesting and roosting conditions but are being managed to meet nesting and roosting area percentages as outlined in table D 5 are managed to develop nesting and roosting conditions as rapidly and as reasonably possible to meet recommended percentages. Prescriptions may include thinning to promote growth of large trees.

Desired Conditions: Management activities that influence the owl and its habitat should be conducted according to the following guidelines:

Manage for Nest / Roost Habitat. Manage mixed-conifer and pine-oak forest types in the designated proportions of Table C.3 (USDI FWS 2012, p. 278) to provide continuous nesting and roosting habitat over space and time. Table C.3 from the Recovery plan is displayed in table D 5. Management of particular stands should be based on their capability to attain the desired conditions (USDI FWS 2012, Table C.2, pp. 275-277).

Table D 5. Minimum desired conditions for pine-oak forest areas managed for Recovery nesting/roosting habitat (USDI FWS 2012)

Forest Type	% of area[1]	% basal area (BA) by size class		Minimum tree BA[2]	Minimum density of large trees[3]
		30-46 cm d.b.h. (12-18 in)	over46 cm d.b.h. (over18 in)		
Pine-oak[4]	20	over30	over30	25.3 (110)	30 (12)

1. Percent of area pertains to the percent of the planning area, subregion, and/or region in the specified forest type that should be managed for threshold conditions.
2. As in m^2/ha (ft^2/acre), and include all trees over1 inch d.b.h. (i.e., any species). We emphasize that values shown are minimums, not targets.
3. Trees over 46 cm (18 inches) d.b.h. Density is tree/ha (trees/acre). Again, values shown are minimums rather than targets. We encourage retention of large trees.
4. Pine-oak forest type: at least 10 percent of the stand basal area or 4.6 m^2/ha (20 ft^2/ac) of basal area consist of Gambel oak at least 13 cm (5 in) diameter at the root collar

Recovery Nesting and Roosting Stands that Currently Do Not Meet Nesting and Roosting Conditions and Recovery Nesting and Roosting Stands that Currently Do Not Meet Nesting and Roosting Conditions Thin and Burn Treatment Design

Treatments Within Recovery Nesting and Roosting Stands: No stand that meets table D 5 conditions should be treated in such a way as to lower that stand below those conditions until ecosystem assessments can document that a surplus of these stands exist at larger landscape levels (e.g., no less than the size of a FS District). This does not preclude use of treatments to reduce fire risks or lessen insect or disease problems, nor does it preclude management to meet other ecosystem objectives, as long as stand-level conditions remain at or above the values given in table D 5.

Select Appropriate Stands to Manage: Management should emphasize attainment of nesting and roosting conditions as quickly as reasonably possible (USDI FWS 2012). Identify and assign stands that would reach these conditions soonest to satisfy area requirements in table D 5.

Retain Large Trees: Stand conditions that provide the owl's nesting habitat frequently vary above the minimum values given in table D 5. Further, important stand conditions cannot be replaced quickly. In particular, removing large trees in a stand identified as habitat could reduce its suitability as nesting habitat or increase the time required to develop suitable nesting habitat. Because it takes many years for trees to reach large size, that trees at least 46- cm (18 inches) d.b.h. not be removed in stands designated as recovery nesting and roosting habitat unless there are compelling safety reasons to do so or if it can be demonstrated that removal of those trees will not be detrimental to owl habitat (USDI FWS 2012).

Strive for Spatial Heterogeneity: Incorporate natural variation, such as irregular tree spacing and various stand/patch/group/clump sizes, into management prescriptions. Strive for heterogeneity both within and between stands. Attempt to mimic natural disturbance patterns and natural landscape heterogeneity. Allow natural canopy gap processes to occur, or mimic those processes through active management, thus producing horizontal variation in stand structure (USDI FWS 2012).

Manage for Species Diversity. Maintain all species of native vegetation on the landscape, including early seral species. Allow for variation in existing stand structures and provide for species diversity (USDI FWS 2012).

Emphasize Large Hardwoods. Within pine-oak and other forest types where hardwoods are a component of owl habitat, emphasis should be placed on management that retains, and promotes the growth of additional, large hardwoods (USDI FWS 2012).

Recovery Nesting and roosting Stands that currently meet Nesting and roosting Conditions and Recovery Nesting and roosting Stands that currently do not meet Nesting and roosting Conditions Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height and reduce litter/duff cover and other surface fuel loading.

Prescribed fires are designed to maintain and enhance desired Mexican spotted owl habitat forest structure, tree densities, snag densities, and coarse woody debris levels.

Forested Recovery Foraging/Non-Breeding Habitat

General Vegetation Management Direction: The following are excerpts from the current Mexican spotted owl Recovery Plan that display guidelines for Forested Recovery Foraging/Non-breeding Habitat as outlined on pages 268-270 of the plan. The intent is to manage recovery habitat so that important but difficult-to-replace habitat elements are conserved while allowing management flexibility. Management should strive to maintain conditions where multiple components occur in proximity to one another. The collective goal of guidelines for Forested Recovery Habitat is to provide spotted owl habitat that is well distributed over space and time. Accomplishing this goal requires maintaining or creating stand structures typical of nesting and roosting habitats, and sustaining them in sufficient amounts and distribution to support a healthy population of Mexican spotted owls (USDI FWS 2012).

Forested Recovery Foraging/Non-Breeding Habitat Mechanical and Burn Treatment Design

The following treatment designs apply to alternative C on the Coconino NF and alternatives B through E on the Kaibab NF. The treatments are designed to implement the current Mexican spotted owl recovery Plan (USDI FWS 2012).

Emphasize Large Hardwoods: Within pine-oak and other forest types where hardwoods are a component of owl habitat, emphasis should be placed on management that retains, and promotes the growth of additional, large hardwoods (USDI FWS 2012).

Retain Large Trees: Strive to retain (do not cut) all trees over 61 cm (over 24 inches) d.b.h., the average diameter of nest trees, unless overriding management situations require their removal to protect human safety and/or property (e.g., the removal of hazard trees along roads, in campgrounds, and along power lines), or in situations where leaving large trees precludes reducing threats to owl habitat (e.g., creating a fuel break). Manage to take reasonable steps to minimize the loss of trees over 61 cm (24 in) d.b.h. Large trees killed by fire will provide a source for recruitment of large snags and eventual large logs; these snags should be retained unless their removal is necessary for public or worker safety (USDI FWS 2012).

Retain Key Owl Habitat Elements: Design and implement management treatments within Forested Recovery Foraging/Non-breeding habitat so that most hardwoods, large snags (over 46 cm [18 in] d.b.h.), large downed logs (over 46 cm [18 in] diameter at any point), trees (over 46 cm [18 in] d.b.h.) are retained, unless this conflicts with forest restoration and/or owl habitat enhancement goals. When implementing this guideline, managers should strive to achieve a balance between retaining a sufficient density and distribution of important features that spotted owls may require and reducing the risk of losing existing roosting and nesting habitat from insect epidemics and stand-replacing fires.

Forested Recovery Foraging/Non-Breeding Habitat Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height, reduce litter/duff cover, and produce effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired Mexican spotted owl restricted other forest structure, tree densities, snag densities, and coarse woody debris levels.

Goshawk Habitat

General – Ponderosa Pine

The description below includes language from RMRS GTR 217 (1992 Reynolds et al.) and is used for this project as a means to track movement towards desired conditions. This language is consistent with the current Coconino NF forest plan, but the language is absent from the Kaibab NF forest plan. The language is consistent Kaibab NF forest plan components including objectives, desired conditions and guidelines (see forest plan consistency crosswalk in the vegetation specialist report).

Vegetation Management Direction: Manage for uneven-age stand conditions for live trees and retain live reserve trees, snags, downed logs, and woody debris levels throughout ponderosa pine forest cover types. Manage for old age trees such that as much old forest structure as possible is

sustained over time across the landscape. Provide for or preserve existing clumps of trees with interlocking crowns. Sustain a mosaic of vegetation densities (overstory and understory), age classes, and species composition across the landscape. Encourage aspen and oak regeneration. Provide habitat for goshawk prey.

Desired Conditions: Highly interspersed, heterogeneous pattern and size of tree groups and interspace across the landscape. Tree groups are dominated by trees of a similar age and range from young to old (uneven-aged). Interspace has a robust herbaceous layer. Where possible create smooth transitions between treated and untreated areas by shaping and feathering edges to make the forest more natural appearing.

Landscapes Outside of Goshawk Post-fledging Areas (LOPFA) – Ponderosa Pine

Vegetation Management Direction: 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. On the Coconino NF for Northern goshawk habitats, distribution of vegetation structural stages for ponderosa pine – 10 percent grass/forb/shrub (VSS 1), 10 percent seedling-sapling (VSS 2), 20 percent young forest (VSS 3), 20 percent mid-aged forest (VSS 4), 20 percent mature forest (VSS 5), 20 percent old forest (VSS6). The distribution of VSS, tree density, and tree age are a product of site quality in the EMA. Use site quality to guide in the distribution of VSS, tree density, and tree ages. Snags are at least 18 inches d.b.h. and at least 30 feet in height, downed logs are 12 inches in diameter and are at least 8 feet long, woody debris is at least 3 inches on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape. Canopy cover guidelines apply only to mid-aged to old forest structural stages (VSS 4, VSS 5 and VSS 6). The VSS distribution of the Coconino NF plan is consistent with the Kaibab NF direction of uneven-aged management and would be used as a metric for moving toward the uneven-aged desired conditions on the Kaibab NF.

Additional project-specific direction is documented in the forest plan amendments that clarify openness and clarify that guidelines for canopy cover apply to mid-aged to old forest structural stage dominated tree groups across the landscapes outside of goshawk post-fledging areas. See FEIS, appendix B.

Desired Conditions: Uneven-aged with a balance of size classes. Within group structure specific to mid-aged to old classes (VSS 4 to 6) includes open understories, interlocking tree crowns, abundant large limbs, and shade.

Landscapes Outside of Goshawk Post-fledging Areas, WUI55, UEA40, UEA25 and UEA10 Mechanical Thin and Burn Treatments Design

Uneven-age thinning and group selection will be used to establish interspace between individual trees and tree groups, thin tree groups, and create regeneration openings within landscapes outside of goshawk post-fledging areas with none to low dwarf mistletoe infections that are uneven age or even age with a quadratic mean diameter at least 8.5 inches.

Treatments will strive to attain an overall average density of 50 to 70 square feet of basal area and 15 to 35 percent of maximum stand density index inclusive of groups, interspaces, and regeneration openings. Density will vary within this range depending on treatment intensity and

existing stand structure. See section E for more detail on the relationship of overall density to interspace, tree groups, and regeneration openings.

Individual trees, tree groups, and interspaces will occupy the following percent of the area by treatment intensity as displayed in table D 6.

Table D 6. Percent of trees, tree groups, and interspaces by treatment intensity (landscapes outside of goshawk post-fledging areas)

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree	Percent of Area Occupied by Interspace
WUI55	30–45	55–70
UEA40	45–60	40–55
UEA25	60–75	25–40
UEA10	75–90	10–25

Individual trees, tree groups, and interspaces will be managed to move toward a balance of age classes, both within and from tree group to tree group, by reducing the most abundant tree size classes and maintaining the underrepresented tree size classes.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree implementation plan (section C) and old trees will not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Per the Collaborative Forest Landscape Restoration Act requirements, treatments in alternatives B through E are designed to focus on small diameter tree thinning, with the objective of maximizing the retention of large trees – thus meeting desired conditions of increasing VSS 5 and 6 age classes as soon as possible. In alternatives C and E, treatments will also follow the guidance in section D, the large tree implementation plan.

To meet the desired condition of increasing VSS 5 and 6 size class, priority of tree retention within groups will focus on existing large trees (generally, trees within the dominant and codominant crown position). Where age class diversity is not present, suppressed and intermediate trees will be retained for vertical diversity.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation plan (section C) by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions, and, (2) that would eliminate direct crown competition on two of the four sides of the old tree.

Openings, on average, will range in size from 0.1 to 1 acre with some exceeding 1 acre (but not to exceed 4 acres). Expected outcomes include treatment unit and landscape heterogeneity. The range of openings will be implemented with variable distribution of opening size. Variability of opening size and location would be determined by aspect, site quality, existing stand structure and pre-settlement tree evidence. Tree groups, on average, will range in size from 0.1 to 1 acre with northerly aspects. Sites with a preponderance of large trees and highly productive microsites would have larger average group sizes. Overall, the average group size will vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

On the Kaibab NF, the predominant 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. On the Coconino NF tree group density in goshawk habitat will be managed to meet the canopy cover requirement (Coconino NF only) of 40 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups except as noted in non- wildland-urban interface stands below. There is no specific guidance in the current Kaibab NF plan for goshawk habitat except in post-fledging family areas. The guidance for the Coconino NF will be used as guidance on the Kaibab NF as well and is consistent with the uneven-aged management guidance of the Kaibab NF plan. This would assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for the desired canopy cover as the groups mature to VSS 4, 5, and 6. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density will meet and exceed the canopy cover requirements. Stocking guidelines for tree groups for the WUI55, UEA40, UEA25, and UEA10 mechanical thin treatments are as described in table D 7.

Table D 7. Landscapes outside of goshawk post-fledging areas wildland-urban interface and uneven-aged treatments stocking guidelines for tree groups

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
1 & 2 (20)	0–4.9	19	48	96	144	193	134–302	NA	NA
3 (20)	5–11.9	14	34	68	102	136	83–215	NA	NA
4 (20)	12–17.9	5	12	23	35	46	35–115	70–146	89–185
5 (20)	18–23.9	3	8	15	23	30	19–59	43–79	54–96
6 (20)	at least 24	2	5	11	16	21	18–38	40–49	51–61

1. These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.
2. Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class; the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section E for further detail on stocking by diameter.

On approximately 28,725 acres (about 16,270 acres on the Coconino and 12,455 acres on the Kaibab NF, respectively) of uneven-aged (UEA) 40, UEA 25 and UEA 10 non- wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 of the VSS4 size class and a mean trees per acre less than 100 of the VSS 4 size class) will be managed for greater residual canopy cover and density of large trees. Residual stand structure will be managed at the upper end of natural range of variability for ponderosa pine in the non- wildland-urban interface stands that meet these conditions. This will be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees Post treatment canopy cover in these stands would meet or exceed forest plan guidance for canopy cover, and will achieve 40 percent canopy cover at the stand scale.

Limited exceptions could occur on areas identified as potential movement corridors for pronghorn and other grassland wildlife species (see AGFD 2011 and Rosenstock and Gist 2014). In those areas, more intensive mechanical thinning of non-old-growth trees and lower levels of residual canopy cover will be allowed. These will be of limited spatial extent and intended to restore natural openings, increase connectivity between natural openings, openings, and facilitate animal movement through treed areas. Manage for tree groups with different size classes by retaining individual and clumps of vigorous ponderosa pine seedlings, sapling, and poles within larger mid-aged, mature, or old tree groups. Both ground-based and remote sensing monitoring will be used to ensure and compare consistency with expected canopy cover levels. Large trees will be the basis for forming groups. Large trees generally, dominant and codominant crown position) would have priority for retention within groups. Where size class diversity is not present, 1 to 10 suppressed and intermediate trees per group will be retained for vertical diversity. Interspace width between tree groups will average from 25 to 120 feet with a maximum width of 200 feet. Average interspace width will vary depending on treatment intensity as described in table D 8.

Table D 8. Interspace percent and width in Landscapes Outside of Goshawk Post-fledging Areas wildland-urban interface (WUI) and uneven-aged (UEA) treatments

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
WUI55	55–70	80–120
UEA40	40–55	60–100
UEA25	25–40	40–60
UEA10	10–25	25–40

Regeneration openings (group selection) account for 10 to 20 percent of tree groups. The percentage will vary within this range depending on current VSS distribution. They will average 0.3 to 0.8 acre and will be no larger than 4 acres or 200 feet wide. Where stand structure dictates, establish regeneration openings by removing groups of trees of VSS3 and smaller diameter VSS4. Regeneration openings will be created adjacent to tree groups and will not be surrounded by interspace.

One group of reserve trees, three to five trees per group, will be left in created regeneration openings greater than an acre in size.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10 inches diameter at the root collar or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18 inches d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18 inches d.b.h. Exceptions to removal will be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species will not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11 inches diameter at the root collar may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation plan in section C), and when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5 inches diameter at the root collar may be considered as residual trees in the target group spacing and stocking.

Snags will be managed for two per acre at least 18 inches, coarse woody debris would be managed for 5 to 7 tons per acre, and downed logs will be managed for three per acre at least 12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired landscapes outside of goshawk post-fledging areas uneven-aged forest structure, tree densities, snag densities, and coarse woody debris levels.

Landscapes Outside of Goshawk Post-fledging Areas Uneven-aged (UEA) Treatment– Arizona Department of Game and Fish Design Mechanical Thin and Burn Design

The design is the same as landscapes outside of goshawk post-fledging areas UEA 10 with the exception of group size. Tree group size is dependent on experimental design and will range in size from 1 to 15 acres.

Landscapes Outside of Goshawk Post-fledging Areas Intermediate Thin (IT) 40, 25, and 10 Mechanical Thin and Burn Treatments Design

Intermediate thinning (IT) will be used to establish interspace between individual trees and tree groups and thin tree groups within landscapes outside of goshawk post-fledging areas sites with moderate to high dwarf mistletoe infection that are uneven age or even age with a quadratic mean diameter at least 8.5 inches.

Treatments will strive to attain an overall average density of 70 to 90 square feet of basal area and 25 to 40 percent of maximum stand density index inclusive of groups and interspaces. Density will vary within these ranges depending on treatment intensity and existing stand structure. See section D for more detail on the relationship of overall density to interspace and tree groups.

Individual trees, tree groups, and interspaces will occupy the following percent of the area by treatment intensity as described in table D 9.

Table D 9. Percent of area occupied by trees, tree groups, and interspace in landscapes outside of goshawk post-fledging areas intermediate thin (IT)

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
IT40	45–60	40–55
IT25	60–75	25–40
IT10	75–90	10–25

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree implementation plan (section C), and old trees will not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars would also be favored for retention.

Per the Collaborative Forest Landscape Restoration Act requirements, treatments are designed to focus on small diameter tree thinning, with the objective of maximizing the retention of large

trees – thus meeting desired conditions of increasing VSS 5 and 6 age classes as soon as possible. Treatments will also follow the guidance in section D, the large tree implementation plan.

To meet the desired condition of increasing VSS 5 and 6 size class, priority of tree retention within groups will focus on existing large trees (generally, trees within the dominant and codominant crown position). Where age class diversity is not present, suppressed and intermediate trees will be retained for vertical diversity.

On approximately 13,300 acres (about 10,430 acres on the Coconino and 2,870 acres on the Kaibab NF, respectively) of IT 40, IT 25 and IT 10 non-wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 of the VSS4 size class and a mean trees per acre less than 100 of the VSS 4 size class) will be managed for greater residual canopy cover and density of large trees. Residual stand structure will be managed at the upper end of natural range of variability for ponderosa pine in the non- wildland-urban interface stands that meet these conditions. This will be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees. Post treatment canopy cover in these stands (measured with both ground-based and remote sensing methods) would meet or exceed forest plan guidance for canopy cover, and will achieve 40 percent canopy cover at the stand scale. Limited exceptions could occur on areas identified as potential movement corridors for pronghorn and other grassland wildlife species (see AGFD 2011 and Rosenstock and Gist 2014). In those areas, more intensive mechanical thinning of non-old-growth trees and lower levels of residual canopy cover will be allowed. These will be of limited spatial extent and intended to restore natural openings, increase connectivity between natural openings, and facilitate animal movement through treed areas.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation plan (section C) by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions, and, (2) that would eliminate direct crown competition on two of the four sides of the old tree.

Openings, on average, will range in size from 0.1 to 1 acre with some exceeding 1 acre (but not to exceed 4 acres). Expected outcomes include treatment unit and landscape heterogeneity. The range of openings will be implemented with variable distribution of opening size. Variability of opening size and location are determined by aspect, site quality, existing stand structure and pre-settlement tree evidence. Tree groups, on average, will range in size from 0.1 to 1 acre with northerly aspects. Sites with a preponderance of large trees and highly productive microsites will have larger average group sizes. Overall, average group size will vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

Tree groups will be managed to improve tree vigor and growth by retaining the best growing dominant and codominant trees with the least amount of mistletoe within each group.

On the Kaibab NF, the predominant 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. The following metrics (below) may be used on the Kaibab NF to assess movement towards uneven-aged conditions. Tree group density

will be managed to meet the canopy cover requirement (Coconino NF only) of 40 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density will meet and exceed the canopy cover requirements. Stocking guidelines for VSS 4, 5, and 6 tree groups for the IT40, IT25, and IT10 mechanical thin treatments are as described in table D 10 and table D 11.

Table D 10. Stocking guidelines for VSS 4 to 6 tree groups in landscapes outside of goshawk post-fledging areas intermediate thin (IT) treatments

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
4 (20)	12–17.9	5	12	23	35	46	35–115	70–146	89–185
5 (20)	18–23.9	3	8	15	23	30	19–59	43–79	54–96
6 (20)	at least 24	2	5	11	16	21	18–38	40–49	51–61

1. These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.
2. Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest trees per acre number for the range pertains to the largest diameter of the VSS class. The highest trees per acre number for the range pertains to the smallest diameter of the VSS class. See section E for further detail on stocking by diameter.

Interspace width between tree groups will average from 25 to 80 feet with a maximum width of 200 feet. Average interspace width will vary depending on treatment intensity as described in table D 11.

Table D 11. Percent and width of interspace in landscapes outside of goshawk post-fledging areas intermediate thin (IT) treatments

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
IT40	40–55	60–80
IT25	25–40	40–60
IT10	10–25	25–40

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree implementation plan (section C), and old trees will not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars will also be favored for retention.

Per the Collaborative Forest Landscape Restoration Act requirements, treatments are designed to focus on small diameter tree thinning, with the objective of maximizing the retention of large trees – thus meeting desired conditions of increasing VSS 5 and 6 age classes as soon as possible. Treatments will also follow the guidance in section D, the large tree implementation plan.

To meet the desired condition of increasing VSS 5 and 6 age class, priority of tree retention within groups will focus on existing large trees (generally, trees within the dominant and codominant crown position). Where age class diversity is not present, suppressed and intermediate trees will be retained for vertical diversity.

Tree groups will be managed to improve tree vigor and growth by retaining the best growing dominant and codominant trees.

Landscapes Outside of Goshawk Post-fledging Areas Stand Improvement (SI) 40, 25, and 10 Mechanical Thin and Burn Treatments Design

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. The following metrics may be used on the Kaibab NF to assess movement towards uneven-aged conditions. Tree group density will be managed to meet the canopy cover requirement (Coconino NF only) of 40 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups. This will assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density will meet and exceed the canopy cover requirements. Stocking guidelines for tree groups for the SI40, SI25, and SI10 mechanical thin treatments are as described in table D 12.

Table D 12. Stocking guidelines for tree groups in landscapes outside of goshawk post-fledging areas stand improvement (SI) treatments

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
1 & 2 (20)	0–4.9	19	48	96	144	193	134–302	NA	NA
3 (20)	5–11.9	14	34	68	102	136	83–215	NA	NA
4 (20)	12–17.9	5	12	23	35	46	35–115	70–146	89–185
5 (20)	18–23.9	3	8	15	23	30	19–59	43–79	54–96
6 (20)	at least 24	2	5	11	16	21	18–38	40–49	51–61

1. These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.
2. Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest trees per acre number for the range pertains to the largest diameter of the VSS class, the highest trees per acre number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Interspace width between tree groups will average from 25 to 80 feet with a maximum width of 200 feet. Average interspace width will vary depending on treatment intensity as described in table D 13.

Table D 13. Interspace percent and width landscapes outside of goshawk post-fledging areas stand improvement (SI) treatments

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
SI40	40–55	60–80
SI25	25–40	40–60
SI10	10–25	25–40

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree implementation strategy, and old trees will not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars will also be favored for retention.

Per the Collaborative Forest Landscape Restoration Act requirements, treatments are designed to focus on small diameter tree thinning, with the objective of maximizing the retention of large trees – thus meeting desired conditions of increasing VSS 5 and 6 age classes as soon as possible. Treatments will follow the large tree implementation plan.

To meet the desired condition of increasing VSS 5 and 6 age class, priority of tree retention within groups will focus on existing large trees (generally, trees within the dominant and codominant crown position). Where age class diversity is not present, suppressed and intermediate trees will be retained for vertical diversity.

On approximately 22 acres (22 acres on the Coconino) of SI 25 non-wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 of the VSS4 size class and a mean trees per acre less than 100 of the VSS 4 size class) will be managed for greater residual canopy cover and density of large trees. Residual stand structure will be managed at the upper end of natural range of variability for ponderosa pine in the non- wildland-urban interface stands that meet these conditions. This will be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees. Post treatment canopy cover (measured with both ground-based and remote sensing methods) in these stands will meet or exceed forest plan guidance for canopy cover, and will achieve 40 percent canopy cover at the stand scale.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10 inches diameter at the root collar or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18 inches d.b.h., and, (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18 inches d.b.h. Exceptions to removal will be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species will not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11 inches diameter at the root collar may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation plan – section C), and when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5 inches diameter at the root collar may be considered as residual trees in the target group spacing and stocking.

Snags will be managed for two per acre at least 18 inches, coarse woody debris will be managed for 5 to 7 tons per acre, and downed logs will be managed for three per acre at least 12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired landscapes outside of goshawk post-fledging areas stand improvement (SI) forest structure, tree densities, snag densities, and coarse woody debris levels.

Landscapes Outside of Goshawk Post-fledging Areas Pine Sage Mechanical and Burn Treatment Design

Restore pre-settlement tree density and pattern using pre-settlement evidence as guidance.

Treatment will strive to attain an overall average density of 30 to 50 square feet of basal area and 15 to 25 percent of maximum stand density index inclusive of individual trees, tree groups, and interspaces. Density will vary within this range depending on existing stand structure. See section E for more detail on the relationship of overall density to interspace and tree groups.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree implementation plan (section C) and old trees will not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars will also be favored for retention.

Per the Collaborative Forest Landscape Restoration Act requirements, treatments are designed to focus on small diameter tree thinning, with the objective of maximizing the retention of large trees – thus meeting desired conditions of increasing VSS 5 and 6 age classes as soon as possible. Treatments will also follow the guidance in section D, the large tree implementation plan.

To meet the desired condition of increasing VSS 5 and 6 age class, priority of tree retention within groups will focus on existing large trees (generally, trees within the dominant and codominant crown position). Where age class diversity is not present, suppressed and intermediate trees will be retained for vertical diversity.

Retain all pre-settlement trees and the largest post-settlement trees available that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences. Some younger trees would also be retained to maintain uneven-aged structure. 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. The following metrics may be used on the Kaibab NF to assess movement towards uneven-aged conditions. Replacement tree density will be managed to meet the attain a canopy cover of 40 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density will meet and exceed the canopy cover requirements. See table D 14 for the stocking guidelines for VSS 4, 5, and 6 tree groups for the pine-sage mechanical thin treatments.

Table D 14. Stocking guidelines for VSS 4 to VSS 6 tree groups in landscapes outside of goshawk post-fledging areas pine-sage treatments

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
4 (20)	12–17.9	5	12	23	35	46	35–115	70–146	89–185
5 (20)	18–23.9	3	8	15	23	30	19–59	43–79	54–96
6 (20)	at least 24	2	5	11	16	21	18–38	40–49	51–61

1. These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.
2. Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest trees per acre number for the range pertains to the largest diameter of the VSS class, the highest trees per acre number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10 inches diameter at the root collar or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18 inches d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18 inches d.b.h. Exceptions to removal will be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak will not be cut unless there is no other option to facilitate logging operations (skid trail and landing locations).

Juniper and pinyon species in the seedling/sapling, young, and mid-aged stages would generally be cut except where needed as replacements for pre-settlement trees. Mature juniper and pinyon will only be cut when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5 inches diameter at the root collar may be considered as residual trees in the target group spacing and stocking.

Snags will be managed for two per acre at least 18 inches, coarse woody debris will be managed for 5 to 7 tons per acre, and downed logs will be managed for three per acre at least 12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired understory composition and cover as well as landscapes outside of goshawk post-fledging areas pine sage forest structure, tree densities, snag densities, and coarse woody debris levels.

Savanna/Grassland Restoration Mechanical and Burn Treatments Design

Restore pre-settlement tree density and pattern using pre-settlement evidence as guidance. Manage for an open reference condition with 10 to 30 percent of the area under ponderosa pine and deciduous tree crowns (see forest plan consistency evaluation in silviculture report).

Manage for the sustainability of identified wildlife corridors for grassland species (see AGFD 2011 and Rosenstock and Gist 2014) by treating these areas to the higher end of percent in interspaces or to a lower ratio of leave tree to evidence ratio.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree implementation plan (section C) and old trees will not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars will also be favored for retention.

Per the Collaborative Forest Landscape Restoration Act requirements, treatments are designed to focus on small diameter tree thinning, with the objective of maximizing the retention of large trees – thus meeting desired conditions of increasing VSS 5 and 6 age classes as soon as possible. Treatments will also follow the guidance in section D, the large tree implementation plan.

To meet the desired condition of increasing VSS 5 and 6 age class, priority of tree retention within groups will focus on existing large trees (generally, trees within the dominant and codominant crown position). Where age class diversity is not present, suppressed and intermediate trees will be retained for vertical diversity.

Tree group arrangement, size, and density are a function of existing pre-settlement trees and evidence. Retain all pre-settlement trees and the largest post-settlement trees that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences at a 1:1 ratio. Some younger trees will also be retained to maintain uneven-aged structure. A higher leave tree to evidence ratio may be required to maintain the desired tree cover range.

Manage for a range of 70 to 90 percent of the treatment area as interspace (grass/forb) between tree groups or individuals. Amount of interspace will vary within this range depending on current conditions.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10 inches diameter at the root collar or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18 inches d.b.h., and, (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18 inches d.b.h. Exceptions to removal will be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak will not be cut unless there is no other option to facilitate logging operations (skid trail and landing locations).

Juniper and pinyon species in the seedling/sapling, young, and mid-aged stages will generally be cut except where needed as replacements for pre-settlement trees. Mature juniper and pinyon will only be cut when there is no other option to facilitate logging operations (skid trail and landing locations).

Snags will be managed for two per acre at least 18 inches, coarse woody debris will be managed for 5 to 7 tons per acre, and downed logs will be managed for three per acre at least 12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired landscapes outside of goshawk post-fledging areas savanna/grassland forest structure, tree densities, snag densities, and coarse woody debris levels.

Landscapes Outside of Goshawk Post-fledging Areas Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height, reduce litter/duff cover, and produce effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired landscapes outside of goshawk post-fledging areas forest structure, tree densities, snag densities, and coarse woody debris levels.

Goshawk Post-Fledging Family Area – Ponderosa Pine

Vegetation Management Direction: Provide for a healthy, sustainable forest environment for the post-fledging family area (PFA) needs. The principle difference between "within the post-fledging family area" and "outside the post-fledging family area" is the higher canopy cover and smaller opening size within the post-fledging family area. Forest conditions in the post-fledging family areas contain 10 to 20 percent higher basal area in mid-aged to old tree groups than in the general forest for the Kaibab NF. The following guidance for the Coconino NF can be used as a metric to arrive at the higher density of 10 to 20 percent higher basal area recommended in the current Kaibab NF plan. For the Coconino NF, vegetative structural stage distribution and structural conditions are the same within and outside the post-fledging family area. Ponderosa pine canopy cover for mid-aged forest (VSS 4) should average one-third 60 plus percent and two-thirds 50 plus percent. Mature (VSS 5) and old forest (VSS 6) should average 50 plus percent. In alternative B-D, forest plan amendment direction (FEIS, appendix B) clarifies that canopy cover guidelines apply to mid-aged to old forest structural stage dominated tree groups (see forest plan consistency crosswalk for the Kaibab NF in the vegetation report)

Desired Conditions: Uneven-aged with a balance of age classes. Within group structure specific to mid-aged to old classes (VSS 4 to 6) includes open understories, interlocking tree crowns, abundant large limbs, and shade.

Dispersal Post-fledging Family Areas / Post-fledging Family Areas in Uneven-aged Treatment (UEA) Types 40, 25, and 10 Mechanical Thin and Burn Treatments Design

Uneven-age thinning and group selection will be used to establish interspace between individual trees and tree groups, thin tree groups, and create regeneration openings within dispersal post-fledging family areas / post-fledging family areas with none to low dwarf mistletoe infections that are uneven age or even age with a quadratic mean diameter at least 8.5 inches.

Treatments will strive to attain an overall average density of 70 to 80 square feet of basal area and 25 to 40 percent of maximum stand density index inclusive of groups, interspaces, and regeneration openings. Density will vary within this range depending on treatment intensity and existing stand structure. See section E for more detail on the relationship of overall density to interspace, tree groups, and regeneration openings.

Individual trees, tree groups, and interspaces will occupy the following percent of the area by treatment intensity as described in table D 15.

Table D 15. Percent of area occupied by individual trees, tree groups, and interspace in dispersal post-fledging family areas / post-fledging family areas uneven-aged (UEA) treatments

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
UEA40	45–60	40–55
UEA25	60–75	25–40
UEA10	75–90	10–25

Individual trees, tree groups, and interspaces will be managed to move toward a balance of age classes, both within and from tree group to tree group, by reducing the most abundant tree size classes and maintaining the underrepresented tree size classes.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree implementation plan (section C) and old trees will not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars will also be favored for retention.

Per the Collaborative Forest Landscape Restoration Act requirements, treatments are designed to focus on small diameter tree thinning, with the objective of maximizing the retention of large trees – thus meeting desired conditions of increasing VSS 5 and 6 age classes as soon as possible. Treatments will also follow the guidance in section D, the large tree implementation plan.

To meet the desired condition of increasing VSS 5 and 6 age class, priority of tree retention within groups will focus on existing large trees (generally, trees within the dominant and codominant crown position). Where age class diversity is not present, suppressed and intermediate trees will be retained for vertical diversity.

On approximately 2,680 acres (about 1,160 acres on the Coconino and 1,520 acres on the Kaibab) of dispersal post-fledging family area UEA 10 ,dispersal post-fledging family area UEA 25, dispersal post-fledging family area UEA 40, post-fledging family area UEA 10 ,post- fledging family area UEA 25 and post-fledging family area UEA 40 non- wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 of the VSS4 size class and a mean trees per acre less than 100 of the VSS 4 size class) will be managed for greater residual canopy cover and density of large trees. Residual stand structure will be managed at the upper end of natural range of variability for ponderosa pine in the non-wildland-urban interface stands that meet these conditions. This will be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees. Post treatment canopy cover (measured with both ground-based and remote sensing methods) in these stands will meet or exceed forest plan guidance for cover, and will achieve for mid-aged forest (VSS 4) on average 1/3 60+ percent and 2/3 50+ percent and for mature (VSS 5) and old forest (VSS 6) should average 50+ percent canopy cover at the stand scale. Limited exceptions could occur on areas identified as potential movement corridors for pronghorn and other grassland wildlife species (see AGFD 2011 and Rosenstock and Gist 2014). In those areas, more intensive mechanical thinning of non-old-growth trees and lower levels of residual canopy cover will be allowed. These will be of limited spatial extent and intended to restore natural openings, increase connectivity between natural openings, and facilitate animal movement through treed areas.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation plan (section C) by reducing crown competition and increasing growing

space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions, and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

Openings, on average, will range in size from 0.1 to 1 acre with some exceeding 1 acre (but not to exceed 4 acres). Expected outcomes include treatment unit and landscape heterogeneity. The range of openings will be implemented with variable distribution of opening size. Variability of opening size and location will be determined by aspect, site quality, existing stand structure and pre-settlement tree evidence. Tree groups, on average, will range in size from 0.1 to 1 acre with northerly aspects. Sites with a preponderance of large trees and highly productive microsites will have larger average group sizes (.25 to 1 acre). Overall, average group size will vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

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 for the Kaibab NF. The following guidance for the Coconino NF can be used as a metric to arrive at the higher density recommended in the current Kaibab NF plan. Tree group density will be managed to meet the canopy cover requirement (Coconino NF only) of mid-aged forest (VSS 4) should average one-third 60 plus percent and two-thirds 50 plus percent. Mature (VSS 5) and old forest (VSS 6) should average 50 plus percent tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density will meet and exceed the canopy cover requirements. Stocking guidelines for tree groups for the dispersal post-fledging family areas / post-fledging family areas UEA40, UEA25, and UEA10 mechanical thin treatments are described in table D 16.

Manage for tree groups with different age classes by retaining individual and clumps of vigorous ponderosa pine seedlings, sapling, and poles within larger mid-aged, mature, or old tree groups.

Table D 16. Stocking guidelines for tree groups in dispersal post-fledging family areas / post-fledging family areas wildland-urban interface and uneven-aged treatments

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
1 & 2 (20)	0–4.9	19	48	96	144	193	134–302	NA	NA
3 (20)	5–11.9	14	34	68	102	136	83–215	NA	NA
4 (20)	12–17.9	7	18	35	53	70	51–115	70–146	89–185
5 (20)	18–23.9	4	10	20	29	39	28–59	43–79	54–96
6 (20)	at least 24	3	7	14	20	27	26–38	40–49	51–61

1. These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4 classes are equivalent to 55 percent canopy cover (guidance for 1/3 60 percent and 2/3 50 is actually 53 percent, 55 percent is a higher average percent canopy cover than the minimum guidance); Densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.
2. Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest trees per acre number for the range pertains to the largest diameter of the VSS class, the highest trees per acre number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Interspace width between tree groups will average from 25 to 70 feet with a maximum width of 200 feet. Average interspace width will vary depending on treatment intensity as described in table D 17.

Table D 17. Interspace percent and width in dispersal post-fledging family areas / post-fledging family areas wildland-urban interface and uneven-aged (UEA) treatments

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
UEA40	40–55	55–70
UEA25	25–40	40–55
UEA10	10–25	25–40

Regeneration openings (group selection) account for 10 to 20 percent of tree groups. They will average 0.3 to 0.8 acre and will be no larger than 2 acres or 200 feet wide. Where stand structure dictates, establish regeneration openings by removing groups of trees of VSS3 and smaller diameter VSS4. Regeneration openings will be created adjacent to tree groups and will not be surrounded by interspace.

One group of reserve trees, three to five trees per group, will be left in created regeneration openings greater than an acre in size.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10 inches diameter at the root collar or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18 inches d.b.h., and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18 inches d.b.h. Exceptions to removal will be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species will not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11 inches diameter at the root collar may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation strategy), and when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5 inches diameter at the root collar may be considered as residual trees in the target group spacing and stocking.

Snags will be managed for two per acre at least 18 inches, coarse woody debris will be managed for 5 to 7 tons per acre, and downed logs will be managed for three per acre at least 12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired dispersal post-fledging family areas / post-fledging family areas with uneven-aged forest structure, tree densities, snag densities, and coarse woody debris levels.

Dispersal Post-fledging Family Areas / Post-fledging Family Areas Uneven-aged (UEA) Forest– Arizona Department of Game and Fish Design Mechanical Thin and Burn Design

Treatment design is similar to dispersal post-fledging family areas / post-fledging family areas UEA10 with the exception of group size. Tree group size is dependent on experimental design and will range in size from 1 to 15 acres.

Dispersal Post-fledging Family Areas / Post-fledging Family Areas Intermediate Thin (IT)40, 25 and 10 Mechanical Thin and Burn Treatments Design

Intermediate thinning will be used to establish interspace between individual trees and tree groups and thin tree groups within dispersal post-fledging family areas / post-fledging family areas with moderate to high dwarf mistletoe infection that are uneven age or even age with a quadratic mean diameter at least 8.5 inches.

Treatments will strive to attain an overall average density of 70 to 90 square feet of basal area and 25 to 40 percent of maximum stand density index inclusive of groups and interspaces. Density will vary within this range depending on treatment intensity and existing stand structure. See section E for more detail on the relationship of overall density to interspace and tree groups.

Individual trees, tree groups, and interspaces will occupy the following percent of the area by treatment intensity as described in table D 18.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree implementation strategy and old trees would not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars will also be favored for retention.

Table D 18. Percent of area occupied by trees and interspace for dispersal post-fledging family areas / post-fledging family areas intermediate thin (IT)

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
IT40	45–60	40–55
IT25	60–75	25–40
IT10	75–90	10–25

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation plan (section C) by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions, and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

Per the Collaborative Forest Landscape Restoration Act requirements, treatments are designed to focus on small diameter tree thinning, with the objective of maximizing the retention of large trees – thus meeting desired conditions of increasing VSS 5 and 6 age classes as soon as possible. Treatments will also follow the guidance in section D, the large tree implementation plan.

VSS4 size class and mean trees per acre less than 100 of the VSS 4 size class will be managed for greater residual canopy cover and density of large trees. Residual stand structure will be managed

at the upper end of natural range of variability for ponderosa pine in the non- wildland- urban interface stands that meet these conditions. This will be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees. Post treatment canopy cover (measured with both ground-based and remote sensing methods) in these stands will meet or exceed forest plan guidance for canopy cover, and will achieve for mid-aged forest (VSS 4) on average 1/3 60+ percent and 2/3 50+ percent and for mature (VSS 5) and old forest (VSS should average 50+ percent canopy cover at the stand scale. Limited exceptions could occur on areas identified as potential movement corridors for pronghorn and other grassland wildlife species (see AGFD 20011 and Rosenstock and Gist 2014). In those areas, more intensive mechanical thinning of non-old-growth trees and lower levels of residual canopy cover will be allowed. These will be of limited spatial extent and intended to restore natural openings, increase connectivity between natural openings, and facilitate animal movement through treed areas.

Openings, on average, will range in size from 0.1 to 1 acre with some exceeding 1 acre (but not to exceed 4 acres). Expected outcomes include treatment unit and landscape heterogeneity. The range of openings will be implemented with variable distribution of opening size. Variability of opening size and location would be determined by aspect, site quality, existing stand structure and pre-settlement tree evidence. Tree groups, on average, will range in size from 0.1 to 1 acre with northerly aspects. Sites with a preponderance of large trees and highly productive microsites will have larger average group sizes (0.25-1 acre in size). Overall, average group size will vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

Tree groups will be managed to improve tree vigor and growth by retaining the best growing dominant and codominant trees with the least amount of mistletoe within each group.

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 for the Kaibab NF. The following guidance for the Coconino NF can be used as a metric to arrive at the higher density recommended in the current Kaibab NF plan. Tree group density will be managed to meet the canopy cover requirement (Coconino NF only) of mid-aged forest (VSS 4) should average one-third 60 plus percent and two-thirds 50 plus percent. Mature (VSS 5) and old forest (VSS 6) should average 50 plus percent tree groups. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density will meet and exceed the canopy cover requirements. Stocking guidelines for VSS 4, 5, and 6 tree groups for the dispersal post-fledging family areas / post-fledging family areas IT40, IT25, and IT10 mechanical thin treatments are described in table D 19 and table D 20.

Interspace width between tree groups will average from 25 to 80 feet with a maximum width of 200 feet. Average interspace width will vary depending on treatment intensity as described in table D 20.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10 inches diameter at the root collar or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18 inches d.b.h., and, (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18 inches d.b.h. Exceptions to removal will be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Table D 19. Dispersal post-fledging family areas / post-fledging family areas intermediate thin (IT) treatments stocking guidelines for VSS 4 – 6 tree groups

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
4 (20)	12–17.9	7	18	35	53	70	51–115	70–146	89–185
5 (20)	18–23.9	4	10	20	29	39	28–59	43–79	54–96
6 (20)	at least 24	3	7	14	20	27	26–38	40–49	51–61

1. These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4 classes are equivalent to 55 percent canopy cover(guidance for 1/3 60 percent and 2/3 50 is actually 53 percent, 55 percent is a higher average percent canopy cover than the minimum guidance); Densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5 and 6.
2. Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest trees per acre number for the range pertains to the largest diameter of the VSS class, the highest trees per acre number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Table D 20. Interspace percent and width in dispersal post-fledging family areas / post-fledging family areas intermediate thin (IT)

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width
IT40	40–55	60–80
IT25	25–40	40–60
IT10	10–25	25–40

Gambel oak, juniper, and pinyon species will not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11 inches diameter at the root collar may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation plan, section C); and when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5 inches diameter at the root collar may be considered as residual trees in the target group spacing and stocking.

Snags will be managed for two per acre at least 18 inches, coarse woody debris will be managed for 5 to 7 tons per acre, and downed logs will be managed for three per acre at least 12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired dispersal post-fledging family areas / post-fledging family areas intermediate thin forest structure, tree densities, snag densities, and coarse woody debris levels.

Dispersal Post-fledging Family Areas / Post-fledging Family Areas Stand Improvement (SI)40, 25, and 10 Mechanical Thin and Burn Treatments Design

Stand improvement thinning will be used to establish interspace between individual trees and tree groups and thin tree groups within dispersal post-fledging family areas / post-fledging family areas even-age sites with a quadratic mean diameter ≤ 8.5 inches and with none to low dwarf mistletoe infection.

Treatments will strive to attain a stand average density of 20 to 25 percent of maximum stand density index inclusive of groups and interspaces. These ranges will vary depending on treatment intensity and existing stand structure. See section E for more detail on the relationship of overall density to interspace and tree groups. Individual trees, tree groups, and interspaces will occupy the following percent of the area by treatment intensity as described in table D 21.

Table D 21. Percent of area occupied by individual trees, tree groups, and interspaces in dispersal post-fledging family areas / post-fledging family areas stand improvement (SI) treatments

Treatment Type and Intensity	Percent of Area Occupied by Individual Trees and Tree Groups	Percent of Area Occupied by Interspace
SI40	45–60	40–55
SI25	60–75	25–40
SI10	75–90	10–25

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree implementation plan (section C), and old trees will not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars will also be favored for retention.

Per the Collaborative Forest Landscape Restoration Act requirements, treatments are designed to focus on small diameter tree thinning, with the objective of maximizing the retention of large trees – thus meeting desired conditions of increasing VSS 5 and 6 age classes as soon as possible. Treatments will also follow the guidance in section D, the large tree implementation plan.

To meet the desired condition of increasing VSS 5 and 6 age class, priority of tree retention within groups will focus on existing large trees (generally, trees within the dominant and codominant crown position). Where age class diversity is not present, suppressed and intermediate trees will be retained for vertical diversity.

On approximately 37 acres (about 37 acres on the Coconino) of post-fledging family area SI 25 non- wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 of the VSS4 size class and a mean trees per acre less than 100 of the VSS 4 size class) will be managed for greater residual canopy cover and density of large trees. Residual stand structure will be managed at the upper end of natural range of variability for ponderosa pine in the non-wildland-urban interface stands that meet these conditions. This will be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees. Post treatment canopy cover (measured with both ground-based and remote sensing methods) in these stands will meet or exceed forest plan guidance for canopy cover, and will achieve for mid-aged forest (VSS 4) on average 1/3 60+ percent and 2/3 50+ percent and for mature (VSS 5) and old forest (VSS 6) should average 50+ percent canopy cover at the stand scale.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation strategy by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to 18 inches d.b.h. that do not meet the old tree definition: (1) within a 50-foot radius that are in the intermediate or suppressed crown positions, and, (2) that will eliminate direct crown competition on two of the four sides of the old tree.

Openings, on average, will range in size from 0.1 to 1 acre with some exceeding 1 acre (but not to exceed 4 acres). Expected outcomes include treatment unit and landscape heterogeneity. The range of openings will be implemented with variable distribution of opening size. Variability of opening size and location would be determined by aspect, site quality, existing stand structure and pre-settlement tree evidence. Tree groups will be managed to improve tree vigor and growth by retaining the best growing dominant and codominant trees.

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 for the Kaibab NF. The following guidance for the Coconino NF can be used as a metric to arrive at the higher density recommended in the current Kaibab NF plan. Tree group density will be managed to meet the canopy cover requirement (Coconino NF only) of mid-aged forest (VSS 4) should average one-third 60 plus percent and two-thirds 50 plus percent. Mature (VSS 5) and old forest (VSS 6) should average 50 plus percent tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5 and 6. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density will meet and exceed the canopy cover requirements. Stocking guidelines for tree groups for the dispersal post-fledging family areas / post-fledging family areas stand improvement types SI40, SI25, and SI10 mechanical thin treatments are described in table D 22 (see Kaibab NF forest plan consistency crosswalk in the vegetation report).

Table D 22. Stocking guidelines for tree groups in dispersal post-fledging family areas / post-fledging family areas stand improvement (SI) treatments

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
1 & 2 (20)	0–4.9	19	48	96	144	193	134–302	NA	NA
3 (20)	5–11.9	14	34	68	102	136	83–215	NA	NA
4 (20)	12–17.9	7	18	35	53	70	51–115	70–146	89–185
5 (20)	18–23.9	4	10	20	29	39	28–59	43–79	54–96
6 (20)	at least 24	3	7	14	20	27	26–38	40–49	51–61

1. These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4 classes are equivalent to 55 percent canopy cover(guidance for 1/3 60 percent and 2/3 50 is actually 53 percent, 55 percent is a higher average percent canopy cover than the minimum guidance); densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.
2. Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest trees per acre number for the range pertains to the largest diameter of the VSS class, the highest trees per acre number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Interspace width between tree groups will average from 25 to 80 feet with a maximum width of 200 feet. Average interspace width will vary depending on treatment intensity as described in table D 23.

Table D 23. Interspace percent and width in dispersal post-fledging family areas / post-fledging family areas stand improvement (SI) treatments

Treatment Type and Intensity	Percent of Area Occupied by Interspace	Average Interspace Width (feet)
SI40	40–55	60–80
SI25	25–40	40–60
SI10	10–25	25–40

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10 inches diameter at the root collar or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18 inches d.b.h., and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18 inches d.b.h. Exceptions to removal will be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species will not be cut with the following exceptions: seedling/sapling, young, and mid-aged pinyon and juniper up to 11 inches diameter at the root collar may be cut within a 50-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation plan, section C); and, when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5 inches diameter at the root collar may be considered as residual trees in the target group spacing and stocking.

Snags will be managed for two per acre at least 18 inches, coarse woody debris will be managed for 5 to 7 tons per acre, and downed logs will be managed for three per acre at least 12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired dispersal post-fledging family areas / post-fledging family areas stand improvement (SI) forest structure, tree densities, snag densities, and coarse woody debris levels.

Dispersal Post-fledging Family Areas / Post-fledging Family Areas Pine Sage Mechanical and Burn Treatment Design

Restore pre-settlement tree density and pattern using pre-settlement evidence as guidance.

Treatments will strive to attain an overall stand average density of 30 to 50 square feet of basal area and 15 to 25 percent of maximum stand density index inclusive of individual trees, tree groups, and interspaces. Density will vary within this range depending on existing stand structure. See section E for more detail on the relationship of overall density to interspace and tree groups.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree

implementation plan (section C), and old trees will not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars will also be favored for retention.

Retain all pre-settlement trees and the largest post-settlement trees available that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences. Some younger trees will also be retained to maintain uneven-aged structure.

Per the Collaborative Forest Landscape Restoration Act requirements, treatments are designed to focus on small diameter tree thinning, with the objective of maximizing the retention of large trees – thus meeting desired conditions of increasing VSS 5 and 6 age classes as soon as possible. Treatments will also follow the guidance in section D, the large tree implementation plan.

To meet the desired condition of increasing VSS 5 and 6 age class, priority of tree retention within groups will focus on existing large trees (generally, trees within the dominant and codominant crown position). Where age class diversity is not present, suppressed and intermediate trees will be retained for vertical diversity.

On approximately 87 acres (about 87 acres on the Kaibab NF) of post-fledging family areas pine sage non- wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 of the VSS4 size class and a mean trees per acre less than 100 of the VSS 4 size class) will be managed for greater residual canopy cover and density of large trees. Residual stand structure will be managed at the upper end of natural range of variability for ponderosa pine in the non- wildland-urban interface stands that meet these conditions. This will be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees. Post treatment canopy cover in these stands will meet or exceed 40 percent, measured at the stand scale.

Replacement tree density will be managed to meet the canopy cover requirement of mid-aged forest (VSS 4) should average one-third 60 plus percent and two-thirds 50 plus percent. Mature (VSS 5) and old forest (VSS 6) should average 50 plus percent tree groups. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density will meet and exceed the canopy cover requirements. Stocking guidelines for VSS 4, 5 and 6 tree groups for the pine sage mechanical thin treatments are as described in table D 24.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10 inches diameter at the root collar or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18 inches d.b.h., and, (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18 inches d.b.h. Exceptions to removal will be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak will not be cut unless there is no other option to facilitate logging operations (skid trail and landing locations).

Table D 24. Stocking guidelines for VSS 4–6 tree groups in dispersal post-fledging family areas / post-fledging family areas pine-sage treatments

VSS Class (% of area)	d.b.h. Class (inches)	Typical Trees Per Group Stocking at the Midpoint Diameter of the VSS Class[1]					Within Group Trees Per Acre Range[2]		
		1/10-ac group	¼-ac group	½-ac group	¾-ac group	1-ac group	Lower Density	Middle Density	Upper Density
4 (20)	12–17.9	7	18	35	53	70	51–115	70–146	89–185
5 (20)	18–23.9	4	10	20	29	39	28–59	43–79	54–96
6 (20)	at least 24	3	7	14	20	27	26–38	40–49	51–61

1. These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4 classes are equivalent to 55 percent canopy cover(guidance for 1/3 60 percent and 2/3 50 is actually 53 percent, 55 percent is a higher average percent canopy cover than the minimum guidance); Densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5 and 6.
2. Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest trees per acre number for the range pertains to the largest diameter of the VSS class, the highest trees per acre number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Juniper and pinyon species in the seedling/sapling, young, and mid-aged stages will generally be cut except where needed as replacements for pre-settlement trees. Mature juniper and pinyon will only be cut when there is no other option to facilitate logging operations (skid trail and landing locations).

Gambel oak, juniper, and pinyon species greater than 5 inches diameter at the root collar may be considered as residual trees in the target group spacing and stocking.

Snags will be managed for two per acre at least 18 inches, coarse woody debris will be managed for 5 to 7 tons per acre, and downed logs will be managed for three per acre at least 12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired dispersal post-fledging family areas / post-fledging family areas savanna/grassland forest structure, tree densities, snag densities, and coarse woody debris levels.

Dispersal Post-fledging Family Areas / Post-fledging Family Areas Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height, reduce litter/duff cover, and produce effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired dispersal post-fledging family areas / post-fledging family areas forest structure, tree densities, snag densities, and coarse woody debris levels.

Nest Area

Vegetation Management Direction: Provide unique nesting habitat conditions for goshawks. Important features include trees of mature to old age with high canopy cover. The structure of the vegetation within nest areas is associated with the forest type, and tree age, size and density, and

the developmental history of the stand. Table D 25 represents RMRS-GTR-217 attributes required for goshawks on location with “low” and “high” site productivity. The nesting area contains only mature to old forest (VSS 5 and 6) having a canopy cover (measured vertically) between 50 to 70 percent with old forest VSS 6 trees 200 to 300 years old. Non-uniform spacing of tree and clumpiness is desirable (see Kaibab NF forest plan consistency crosswalk in the vegetation report).

Desired Conditions: Even-aged dominated by mature and/or old forest structural stages.

Goshawk Nest Area Burn Only Treatment Design

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible.

Prescribed fires are designed to increase tree canopy base height and reduce litter/duff cover and other surface fuel loading.

Prescribed fires are designed to maintain and enhance desired dispersal post-fledging family areas / post-fledging family areas forest structure, tree densities, snag densities, and coarse woody debris levels. Desired goshawk nest stand structural attributes are as described in table D 25.

Table D 25. Minimum structural attributes in suitable goshawk nest stands*

Structural Attribute	Minimum Metrics	
Site Index	under 55	at least 55
Trees/Acre	40	30
Mean d.b.h. (in.)	16	22
Age (yrs.)	200+	200+
Total basal area (sq. ft./acre)	120	140
Overstory canopy cover	50+	60+
VSS	5B-6	5B-6

* GTR-RM-217, southwest ponderosa pine cover types

Landscapes Outside of Goshawk Post-fledging Areas (LOPFA) – Pinyon-Juniper

Vegetation Management Direction: Manage for uneven-age conditions to sustain a mosaic of vegetation densities (overstory and understory), age classes, and species composition well distributed across the landscape. Provide for reserve trees, snags, and down woody debris.

Desired Conditions: Mosaic of young and mature, species diverse patches of trees interspersed with interspace across the landscape to promote the growth of sagebrush, oak, cliffrose, and other shrubs and herbaceous understory species. Mature patches would be structurally diverse, containing large live and dead standing trees as well as trees with dead or broken tops, gnarls, and burls. The structure and composition reflects the natural range of variability.

Pinyon Juniper (PJ) Wildland-urban Interface Mechanical Thin and Burn Treatment Design

Uneven-age thinning will be used to establish interspace between tree groups and thin tree groups within landscapes outside of goshawk post-fledging areas pinyon juniper sites.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree implementation plan (section C), and old trees would not be targeted for cutting. Live conifer trees with existing cavities and dead tops will also be favored for retention.

Retain one to three groups per acre containing approximately 5 to 30 trees each (averaging 30 to 60 trees per acre across the site). Form groups around existing concentrations of large, mature trees. Retain additional healthy, young, free-to-grow trees within groups where possible.

Between groups, thin from below to 16 inches diameter at the root collar for pinyon and juniper and 16 inches d.b.h. for ponderosa pine.

Where ponderosa pine is present, retain all pre-settlement yellow pines and one to two replacement blackjacks per existing yellow pine or pre-settlement evidence (i.e., to approximate the naturally occurring stand composition). Replacement blackjacks should be comprised of a variety of size classes. Blackjacks will be retained within 100 feet of the yellow pine or pre-settlement evidence they are replacing.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10 inches diameter at the root collar or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18 inches d.b.h., and, (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18 inches d.b.h. Exceptions to removal will be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak will not be cut with the exception of when there is no other option to facilitate logging operations (skid trail and landing locations).

Snags will be managed for one per acre over 75 percent of the area and coarse woody debris will be managed for an after treatment average of 1 to 3 tons per acre. Where available, a portion of the coarse woody debris will include two logs at least 10 inches and at least 10 feet in length.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired landscapes outside of goshawk post-fledging areas pinyon juniper wildland-urban interface forest structure, tree densities, snag densities, and coarse woody debris levels.

Other Areas outside Mexican Spotted Owl and Goshawk Habitats

Aspen

Vegetation Management Direction: Conifer removal, partial removal of overstory aspen, ground-disturbing activities, and fire will be used to stimulate aspen sprouting in areas that have or previously had aspen.

Desired Conditions: Aspen is successfully regenerating and recruiting into older and larger size classes. Size classes have a natural distribution, with the greatest number of stems in the smallest classes. Coniferous species comprise less than 10 percent of the overstory.

Aspen Mechanical Thin and Burn Treatment Design

Inclusions of aspen remnants within portions of ponderosa pine stands will be regenerated by removing all post-settlement conifers from within 100 feet of the aspen clone. Some removal of aspen within the clone as well as ground-disturbing activity or burning may occur to stimulate suckering.

Per the Collaborative Forest Landscape Restoration Act requirements, treatments are designed to focus on small diameter tree thinning, with the objective of maximizing the retention of large trees – thus meeting desired conditions of increasing VSS 5 and 6 age classes as soon as possible. Treatments will also follow the guidance in section D, the large tree implementation plan.

To meet the desired condition of increasing VSS 5 and 6 age class, priority of tree retention within groups will focus on existing large trees (generally, trees within the dominant and codominant crown position). Where age class diversity is not present, suppressed and intermediate trees will be retained for vertical diversity.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree implementation plan (section C), and old trees will not be targeted for cutting. Live conifer trees with existing cavities, dead tops, and lightning scars will also be favored for retention.

Snags will be managed for two per acre at least 18 inches, coarse woody debris will be managed for 5 to 7 tons per acre, and downed logs will be managed for three per acre at least 12 inches.

Each clone will be evaluated as to need for fencing or creation of other barriers to reduce ungulate browsing of regenerating aspen.

Prescribed burns may be used where and when feasible to treat fuels, mitigate fuel hazards, and to produce effects that stimulate aspen suckering and regeneration, and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired aspen forest structure, tree densities, snag densities, and coarse woody debris levels.

Aspen Burn Only Treatment Design

Inclusions of aspen remnants within portions of ponderosa pine stands will be regenerated by prescribed burning to stimulate suckering.

Prescribed burns are designed to reduce post-settlement conifer stocking within 100 feet of the aspen clone and disturb the site with sufficient intensity to encourage aspen regeneration.

Each clone will be evaluated as to need for fencing or creation of other barriers to reduce ungulate browsing of regenerating aspen.

Grassland

Vegetation Management Direction: Reduce conifer encroachment within grasslands as identified by mollisol soils.

Desired Conditions: Restore historic grassland/forest edge as indicated by existing pre-settlement conifers and evidence of pre-settlement conifers.

Grassland Mechanical Thin and Burn Treatment Design

Treatments are designed to promote and reestablish the historic meadow edge as defined by pre-settlement trees and evidences and the current forest structure of young trees encroaching on the edge of the grassland.

Treatments are designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape. Treatments will follow the old tree implementation plan (section C), and old trees will not be targeted for cutting. Live conifer trees with existing cavities and dead tops will also be favored for retention.

Tree group arrangement, size, and density are a function of existing pre-settlement trees and evidence. Retain all pre-settlement trees and the largest post-settlement trees that most closely resemble old trees in size and form as replacement trees adjacent to pre-settlement tree evidences at a 1:1 ratio. Ponderosa pine, pinyon, and juniper not meeting long-lived characteristics may be removed.

Gambel oak will be retained.

Prescribed burns may be used where and when feasible to treat fuels, mitigate fuel hazards, and to produce effects that stimulate regeneration and growth of native herbaceous vegetation.

Prescribed fires are designed to maintain and enhance desired grassland conditions.

Section B – Decision Matrix

Table D 26. Section B decision matrix for establishing tree groups, interspace, and regeneration openings

Feature	Placement	Reserve Trees within Feature	Thinning	Thinning Leave Tree Criteria	Large Tree Implementation Plan (Alternative C)
Tree Group	1 – Abundance of pre-settlement tree evidence 2 – Underrepresented tree classes (e.g., free to grow seedling/saplings; trees of different cohort than neighboring trees) 3 – High percentage of trees exhibiting good health and vigor 4- Groups dominated by a preponderance of large young trees	1 – Old tree characteristics (old tree implementation plan) regardless of size 2 – Oak, pinyon, and juniper with exceptions 3 – Wildlife trees (cavities, dead tops)	Tree group stocking guidelines.	1 – Trees in the dominant and codominant crown position exhibiting vigor relative to age regardless of size (usually large young trees) 2 – Crown ratio >40% desirable; crown ratio 25–40% acceptable 3 – Free of mistletoe or low dwarf mistletoe rating relative to neighboring trees; free of pine beetle activity 4 – Trees >12″ high percentage of interlocking crown; Trees <12″ ability to develop interlocking crown	Heavily-Stocked Stands (with high BA) Generated by a Preponderance of Large, Young Trees Does the decision matrix meet the conditions described by the large tree implementation plan category: Yes _____ No _____ If no, describe what the condition(s) is, and why it does not meet the exception: _____ _____ Ponderosa Pine/Gambel Oak Forest Does the decision matrix meet the conditions described by the large tree implementation plan category: Yes _____ No _____ If no, describe what the condition(s) is, and why it does not meet the exception: _____ _____

Feature	Placement	Reserve Trees within Feature	Thinning	Thinning Leave Tree Criteria	Large Tree Implementation Plan (Alternative C)
Interspace	1 – Little to no pre–settlement tree evidence 2 – Existing nonstocked openings 3 – High percentage of trees exhibiting poor health and vigor 4 - Contiguous area of well-represented cohorts	1 – Old tree characteristics (old tree implementation plan) regardless of size. 2 – Oak, pinyon and juniper 3 – Wildlife trees (cavities, dead tops)	NA	NA	Within-Stand Openings: Does the decision matrix meet the conditions described by the large tree implementation plan category: Yes _____ No _____ If no, describe what the condition(s) is, and why it does not meet the exception: _____ _____
Regeneration Opening	1 – Contiguous area of well-represented cohort. 2 – Isolated patch of mistletoe infected trees within the well-represented cohort. 3 – Adjacent to seed bearing tree groups that are free of mistletoe infection. 4- Where stand structure dictates, establish regeneration openings by removing groups of trees of VSS3 and smaller diameter VSS4. Avoid placing in preponderance of large young trees.	1 – Old tree characteristics (old tree implementation plan) regardless of size. 2 – Oak, pinyon, and juniper 3 – Wildlife trees (cavities, dead tops) 4 – Largest, healthiest, seed bearing ponderosa pine (within openings >1 ac)	NA	NA	NA

Section C – Old Tree Implementation Plan

Old Tree Descriptions and Illustrations

Old trees (approximately over 150 years old) would be retained, with few exceptions, regardless of their diameter, within the 4FRI on the Coconino and Kaibab NF's EIS area. Removal of old trees would be rare. Exceptions would be made for threats to human health and safety, and those rare circumstances where the removal of an old tree is necessary in order to prevent additional habitat degradation. Old trees will not be cut for forest health issues or to balance age or size class distributions.

One example of a situation where the removal of an old tree is necessary in order to prevent additional habitat degradation is in the rare case of an old tree growing on the side of an existing curve in a road. Logging equipment may require a wider turning radius. The options are to relocate the road or cut the old tree and widen the curve to accommodate the larger turning radius. Relocating the road would result in a larger area of the forest being permanently disturbed, versus cutting the large tree and widening the curves radius. This is an example where cutting the old tree would result in less habitat degradation then relocating a road.

Old trees will be determined by the following characteristics described by Thomson (1940) as 3 (intermediate-mature) and 4 (mature to over-mature).

- Age – Approximately 150 years and older.
- D.b.h. – Site dependent.
- Bark – ranging from reddish brown, shading to black in the top with moderately large plates between the fissures to reddish brown to yellow, with very wide, long, and smooth plates.
- Tops – ranging from pyramidal or rounded (occasionally pointed) to flat (making no further height growth).
- Branching – ranging from upturned in upper third of the crown, horizontal in the middle third, and drooping in the lower third of the crown to mostly large, drooping, gnarled, or crooked. Branch whorls range from incomplete and indistinct except at the top to completely indistinct and incomplete.

Figure D 1 and figure D 2 display illustrations of size class 3 (intermediate-mature) and size class 4 (mature-overmature) from Thompson 1940.

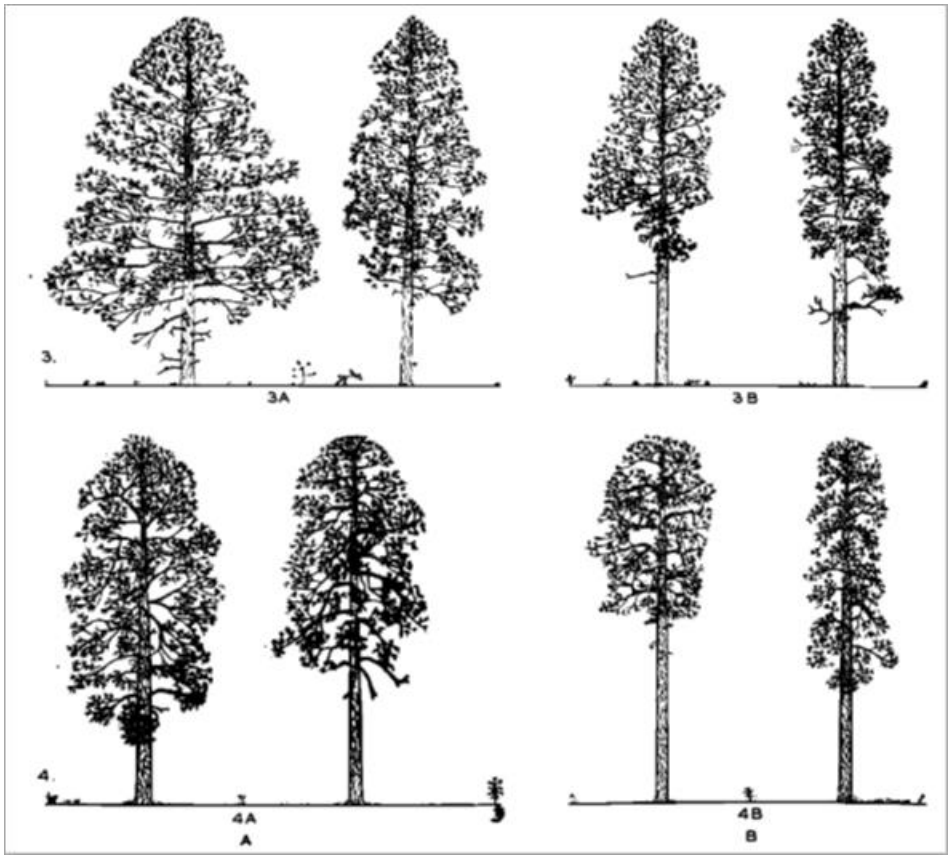

Figure D 1. Old tree characteristics (Thompson 1940)

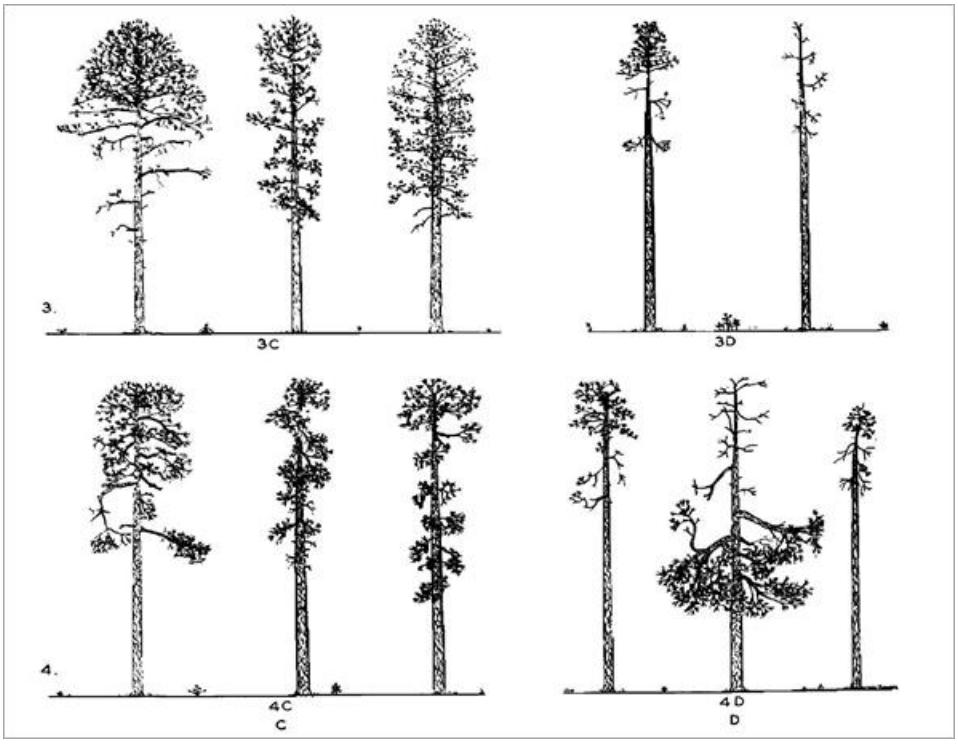

Figure D 2. Old age tree characteristics continued (Thompson 1940)

Section D – Modified Large Tree Implementation Plan

Introduction

The large tree implementation plan is designed to reflect the Collaborative Forest Landscape Restoration Act requirements regarding large tree retention by clarifying the intent to focus restoration treatments on small-diameter tree thinning, to retain large trees whenever possible, and to more specifically design treatments so that large trees will be retained unless they must be cut to meet the desired conditions listed in the categories below. It responds to comments received during scoping (August 2011). The plan's desired conditions are consistent with the summarized desired conditions found in the project's purpose and need and the plan provides additional citations that support the desired conditions. It incorporates the old tree implementation plan by reference.

For the purpose of this document, large post-settlement trees, as defined by the socio-political process, are those that are 16 inches d.b.h. or larger. Trees greater than or equal to 18 inches d.b.h. represent VSS 5 and 6. VSS 5 and 6 represent the largest and (sometimes) oldest trees. These size classes best correspond with the successional age classification system that was developed to address the forest dynamics of southwestern ponderosa pine.

The plan may not include every instance where large post-settlement trees may be cut. There may be additional areas and/or circumstances where large post-settlement trees need to be removed in order to achieve restoration objectives. During implementation (prescription development), if a condition exists that does not the meet the desired conditions included in this strategy, no large trees will be cut until the NEPA decision is reviewed by the Forest Service implementation team. The team will decide whether the action is consistent with the analysis and the decision made. This information will be made part of the annual implementation plan checklist/compliance review that is recommended by the team and approved by the forest supervisor.

Seeps and Springs

Seeps are locations where surface-emergent groundwater causes ephemeral or perennial moist soil or bedrock. Standing or running water is infrequent or absent. Vegetation and other biological diversity are adapted to mesic soils. Springs are small areas where surface-emergent groundwater causes ephemeral or perennial standing or running water and wet or moist soils. Vegetation and other biological diversity are adapted to mesic soils or aquatic environments (Feth and Hem 1963).

Seeps and springs exhibit unique, often isolated biophysical conditions that can sustain unique, mesic-adapted biological diversity, and can facilitate endemism and speciation. Springs also provide water and other habitat to terrestrial wildlife. Due to the absence of frequent fires in the presence of livestock grazing, the establishment of large post-settlement trees may reduce available soil moisture (Simonin et al. 2007) and block the sunlight necessary to support the unique biophysical conditions associated with seeps and springs.

Removal of trees that have encroached upon seeps and springs may constitute a relatively small part of an overall seep and spring restoration effort, when compared to fully addressing root causes of overall degradation. Thinning alone, without addressing other sources of degradation, is unlikely to fully restore seeps and springs (Thompson et al. 2002). However, it is a necessary step leading to the restoration of these ecologically important areas.

Desired Conditions

- The biophysical conditions in seeps and springs upon which terrestrial, mesic-adapted, and aquatic native biological diversity depend are conserved and restored.
- The integrity of the spring's unique biophysical attributes is not compromised by tree shading.
- Mesic soils associated with a seep or spring are not encroached upon by conifers.
- If treatment occurs, an equivalent number of large replacement trees remain where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past.

Riparian

Riparian areas occur along ephemeral or perennial streams or are located downgradient of seeps or springs. These areas exhibit riparian vegetation, mesic soils, and/or aquatic environments.

Riparian areas exhibit unique biophysical conditions that can sustain unique, mesic-adapted, or aquatic biological diversity. Riparian areas and the streams, springs, and seeps connected to them often harbor imperiled species that can be sources of endemism. Riparian areas also provide water and other habitat to terrestrial wildlife. In the absence of frequent fires and in the presence of other competing factors, large post-settlement trees may have become established and grown within riparian areas to the point that they compromise available soil moisture or light that support the unique biophysical conditions that are associated with the riparian areas. However, it is likely to be a very rare circumstance that conifer trees of any size would need to be removed from forested riparian zones.

Desired Conditions

- The biophysical conditions in riparian habitat upon which terrestrial and aquatic native biological diversity depends are conserved and restored.
- The use of soil and water best management practices (BMPs) minimize the impacts of cutting trees within riparian areas.
- Removal of trees constitutes a relatively small part of an overall riparian area restoration effort, when compared to the fundamental causes of overall degradation. Riparian areas are fully restored by using an array of tools that address all sources of degradation.
- Available soil moisture or light that support that area's unique biophysical conditions is not compromised by growing (rooted) trees.
- If treatment occurs, an equivalent number of large replacement trees remain where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past.
- Post-treatment snags and logs that include large trees are available onsite.

Wet Meadows

High elevation streamside or spring-fed meadows occur in numerous locations throughout the Southwest. However, less than 1 percent of the landscape in the region is characterized as wetland (Dahl 1990), and wet meadows are just one of several wetland types that occur. Patton and Judd

(1970) reported that approximately 17,700 hectares of wet meadows occur on national forests in Arizona and New Mexico.

Wet meadows may be referred to as riparian meadows, montane (or high elevation) riparian meadows, sedge meadows, or simply as wet meadows. Wet meadows are usually located in valleys or swales, but may occasionally be found in isolated depressions, such as along the fringes of ponds and lakes with no outlets. Where wet meadows have not been excessively altered, sedges (*Carex* spp.), rushes (*Juncus* spp.), and spikerush (*Eleocharis* spp.) are common species (Patton and Judd 1970, Hendrickson and Minckley 1984, Muldavin et al. 2000). Willow (*Salix*) and alder (*Alnus*) species often occur in or adjacent to these meadows (Long 2000, Long 2002, Maschinski 2001, Medina and Steed 2002). High elevation wet meadows frequently occur along a gradient that includes aquatic vegetation at the lower end and mesic meadows, dry meadows, and ponderosa pine or mixed conifer forest at the upper end. These vegetation gradients are closely associated with differences in flooding, depth to water table, and soil characteristics (Judd 1972, Castelli et al. 2000, Dwire et al. 2006). While relatively rare, wet meadows are believed to be of disproportionate value because of their use by wildlife and the range of other ecosystem services they provide. Wet meadows perform many of the same ecosystem functions associated with other wetland types, such as water quality improvement, reduction of flood peaks, and carbon sequestration.

Wet meadows are one of the most heavily altered ecosystems. They have been used extensively for grazing livestock, have become the site of many small dams and stock tanks, have had roads built through them, and have experienced other types of hydrologic alterations. Most notably, the lowering of their water tables due to stream downcutting, surface water diversions, or groundwater withdrawal (Neary and Medina 1996) has occurred. In the presence of livestock grazing and hydrologic changes, large post-settlement trees may have established and grown within wet meadows such that they compromise available soil moisture or light creating unique biophysical conditions.

Desired Conditions

- The biophysical conditions of wet meadows upon which terrestrial native biological diversity depend are conserved and restored.
- Wet meadow function is not impaired by growing (rooted) trees.
- If treatment occurs, an equivalent number of large replacement trees remain where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past.
- Removal of large trees constitutes a relatively small part of an overall riparian area restoration effort, when compared to the fundamental causes of overall degradation. Wet meadows are fully restored by using an array of tools that address all sources of degradation.

Encroached Grasslands

Encroached grasslands are herbaceous ecosystems that have infrequent to no evidence of pine trees growing prior to settlement. The two prevalent grassland categories in the 4FRI landscape are montane (includes subalpine) grasslands and Colorado Plateau (a subset of Great Basin) grasslands, with montane grasslands being most common (Finch 2004). A key indicator of grasslands is the presence of mollisol soils. Mollisol soils are typically deeper with higher rates of accumulation and decomposition of soil organic matter relative to soils in the surrounding landscape. Grasslands in this region evolved during the Miocene and Pliocene periods, and the

dark, rich soils observed in grasslands today have taken more than 3 million years to produce. In addition to their association with mollic soils, grasslands in this region are maintained by a combination of climate, fire, wind desiccation, and, to a lesser extent, by animal herbivory (Finch 2004).

Typical montane grasslands in this region are characterized by Arizona fescue (*Festuca arizonica*) meadows on elevated plains of basaltic and sandstone residual soils. Montane grasslands generally occur in small (under 100 acres) to medium sized (100 to 1,000 acres) patches. Historic maintenance of the herbaceous condition in these grasslands is subject to some debate though appears to be primarily driven by periodic fire. The cool-season growth of Arizona fescue also plays a large role in maintenance of parks and openings by directly competing with ponderosa pine seedlings. Identification of grasslands in this region should use a combination of the TES, Southwest Regional GAP Analysis, and Brown and Lowe Vegetation Classification (Brown and Lowe 1982, TNC GIS Layer 2006) among other existing vegetation and soils data.

Prior to European settlement, pine trees were rarely established in grasslands because they were either outcompeted by production of cool-season grasses or killed by frequent fire (Finch 2004). In the late 1800s, unsustainable livestock grazing practices significantly reduced herbaceous cover, reducing competition pressure on pine seedlings. Coupled with the onset of fire suppression in the early 1900s, pine trees rapidly encroached and recruited into native grasslands (e.g., Moore and Huffman 2004, Coop and Givnish 2007). Plant diversity is particularly important in grassland ecosystems. Grassland plots with greater species diversity have been found to be more resistant to drought and to recover more quickly than less diverse plots (Tilman and Downing 1994). This resilience will become even more important in a warming climate. Pine tree removal, restoration of fire, and complementary reductions in livestock grazing pressure are all necessary to restore structure and function of native grasslands.

Desired Conditions

- Grasslands are enhanced, maintained, and function with potential natural vegetation (as defined by vegetative mapping units).
- Grasslands function with a natural fire regime.
- Existing grasslands are not encroached upon by conifers.
- If treatment occurs, an equivalent number of large replacement trees remain where there is evidence that pre-settlement trees have grown in similar root and crown proximity to a particular seep or spring in the past.

Aspen Forest and Woodland

Quaking aspen (*Populus tremuloides*) occurs in small patches throughout the 4FRI project area. Bartos (2001) refers to three broad categories of aspen: (1) stable and regenerating (stable), (2) converting to conifers (seral), and (3) decadent and deteriorating. Almost all of the aspen occurring within ponderosa pine forests of the 4FRI project area is seral aspen, which regenerates after disturbance through root sprouting and rarely from seed production (Quinn and Wu 2001). Favorable soil and moisture conditions maintain stable aspen over time. Aspen stands have been mapped across the entire 4FRI area and map layers are available from existing databases.

Aspen occurs within ponderosa pine forests. It is ecologically important due to the high concentration of biodiversity that depends on aspen for habitat (Tew 1970, DeByle 1985, Finch and Reynolds 1987, Griffis-Kyle and Beier 2002). In addition, stable aspen stands serve as an

indicator of ecological integrity (Di Orio et al. 2005). Aspen is currently declining at an alarming rate (Fairweather et al. 2008).

The lack of fire as a natural disturbance regime in southwestern ponderosa pine forests since European settlement has caused much of the aspen dominated lands to cede to conifers (Bartos 2001). Other factors contributing to gradual aspen decline over the past 140 years include reduced regeneration from browsing ungulates including livestock (Pearson 1914, Larson 1959, Martin 1965, Jones 1975, Shepperd and Fairweather 1993, Martin 2007) and introduced and native wild ungulates in the absence of natural predators like wolves (Ripple and Beschta 2207, 2011, Hebblewhite et al. 2005). More recently, aerial and ground surveys indicate more rapid decline of aspen, with very high mortality occurring in low and mid-elevation aspen sites. Major factors thought to be causing this rapid decline of aspen include frost events, severe drought, and a host of insects and pathogens (Fairweather et al. 2008) that have served as the "final straws" for already compromised stands. Desired Conditions:

Desired Conditions

- Aspen forests and woodlands are conserved and restored to their appropriate fire regime.
- Aspen is effectively being regenerated or maintained, and regeneration, saplings, and juvenile trees are protected from browsing.
- There is decreased competition from ponderosa pine. Post-settlement ponderosa pine tree numbers do not exceed residual targets that have been identified using pre-settlement conifer tree evidences, site visitations, and collected data.
- Removal of large trees constitutes a relatively small part of the aspen restoration effort, when compared to the fundamental causes of overall degradation. Aspen forests and woodlands are fully restored by using an array of tools that address all sources of degradation.

Ponderosa Pine/Gambel Oak Forest (Pine-Oak PIPO/QUGA)

A number of habitat types exist in the southwestern United States that could be described as pine-oak. Ponderosa pine forests are interspersed with Gambel oak trees in locations throughout the 4FRI area in a habitat association referred to as PIPO/QUGA (USDA FS 1997, USDI FWS 1995).

In southwestern ponderosa pine forests, Gambel oak has several growth forms distinguished by stem sizes and the density and spacing of stems within clumps. These include shrubby thickets of small stems, clumps of intermediate-sized stems, and large, mature trees that are influenced by age, disturbance history, and site conditions (Kruse 1992, Rosenstock 1998, Abella and Springer 2008, Abella 2008a). Different growth forms provide important habitat for a large number and variety of wildlife species (Neff et al. 1979, Kruse 1992). These include hiding cover in a landscape with limited woody shrub cover, cavity substrate for birds and bats, roost potential for bats, nest sites for birds, and bark characteristics used by invertebrates. Whether as saplings, shrubby thickets, or larger sized trees, oak adds a high value for wildlife in ponderosa pine forests.

Gambel oak provides high quality wildlife habitat in its various growth forms and is a desirable component of ponderosa pine forests (Neff et al. 1979, Kruse 1992, Bernardos et al. 2004). Gambel oak enhances soils (Klemmedson 1987), wildlife habitat (Kruse 1992, Rosenstock 1998, USDI FWS 1995, Bernardos et al. 2004), and understory community composition (Abella and Springer 2008). Large oak trees are particularly valuable since they typically provide more natural cavities and pockets of decay that allow excavation and use by cavity nesters than

conifers. In addition to its important ecological role, Gambel oak has high value to humans as it is a popular firewood that possesses superior heat-producing qualities compared to other tree species (Wagstaff 1984).

Although management on public lands with regard to oak has changed to better protect the species, illegal firewood cutting of Gambel oak, and elk and livestock grazing negatively impact oak growth and regeneration (Harper et al. 1985, Clary and Tiedemann 1992). Illegal firewood cutting of Gambel oak continues to result in the removal of rare, large diameter oak trees (Bernardos et al. 2004).

A literature review by Abella and Fulé (2008) found that Gambel oak densities appear to have increased in many areas with fire exclusion, especially in the small and medium diameter stems (under 8 inches d.b.h.). Chambers (2002) found that Gambel oak on the Kaibab and Coconino NFs was distributed in an uneven-aged distribution, dominated by smaller size classes (under 5 centimeter d.b.h.) and few large diameter oak trees. Because of Gambel oak's slow growth rate, there may be little opportunity for these small Gambel oak trees to attain large diameters (over 85 centimeters) (Chambers 2002).

Pine competition with oak has been identified as an issue in slowing oak growth, particularly for older oaks (Onkonburi 1999). Onkonburi (1999) also found that for northern Arizona forests, pine thinning increased oak incremental growth more than oak thinning and prescribed fire. Fulé (2005) found that oak diameter growth tended to be greater in areas where pine was thinned relative to burn only treatments and controls. Thinning of competing pine trees may promote large oaks with vigorous crowns and enhanced acorn production (Abella 2008b), and may increase oak seedling establishment (Ffolliott and Gottfried 1991).

Desired Conditions

All Gambel Oak

- Small oak trees develop into larger size classes.
- Fire treatments retain small and shrubby oak in numbers and distribution.
- All growth forms of Gambel oak are present and larger, older oak trees are enhanced and maintained.
- Large, post-settlement trees are not restricting oak development.
- Frequent, low intensity surface fire occurs in ponderosa pine-Gambel oak forests.
- Brushy thicket, pole, and dispersed clump growth forms of Gambel oak are present and maintained by allowing natural self-thinning, thinning dense clumps, and/or burning.
- Gambel oak growth forms are protected from damage during restoration treatments including thinning and post-thinning slash burning.
- Non-wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 and a mean trees per acre less than 100) would be managed for greater residual canopy cover and density of large trees. Residual stand structure would be managed at the upper end of natural range of variability for ponderosa pine in the non- wildland-urban interface stands that meet these conditions. This would be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes, and/or retaining additional large trees.

In Mexican Spotted Owl Restricted Habitat

- Within Mexican spotted owl habitat and designated critical habitat, the recovery plan for the Mexican spotted owl improves key habitat components and primary biological factors, which includes Gambel oak.
- Within 30 feet of oak 10- inch diameter at the root collar or larger, post-settlement mixed conifer trees up to 18 inches d.b.h. (that do not have interlocking crowns with oak) are not restricting oak development.

Outside Mexican spotted owl Restricted Habitat

- Large post-settlement trees' drip lines or roots do not overlap with those of Gambel oak trees over 8 inch diameter at the root collar.

Within-stand Openings

Within-stand openings are small openings (generally 0.05 to 1.0 acres) that were occupied by grasses and wildflowers before settlement (Pearson 1942, White 1985, Covington and Sackett 1992, Sánchez Meador et al. 2009). For the purposes of this strategy, within-stand openings are equivalent to interspaces. The within-stand opening management approach described below is distinct from, and should not be considered as guidance relating to regeneration openings.

Pre-settlement openings can be identified by the lack of stumps, stump holes, and other evidence of pre-settlement tree occupancy (Covington et al. 1997). These openings are most pronounced on sites with heavy textured (e.g., silt-clay loam) soils (Covington and Moore 1994). Current openings include fine-scaled canopy gaps. It is not necessary to have desired within-stand openings and groups located in the same location that they were in before settlement (the site fidelity assumption). Trees might be retained in areas that were openings before settlement, and openings might be established in areas which had previously supported pre-settlement trees.

Within-stand openings appear to have been self-perpetuating before overgrazing and fire exclusion (Pearson 1942, Sánchez Meador et al. 2009). Fully occupied by the roots of grasses and wildflowers as well as those of neighboring groups of trees, these openings had low water and nutrient availability because of intense root competition (Kaye et al. 1998). Heavy surface fuel loads insured that tree seedlings were killed by frequent surface fires, reinforcing the competitive exclusion of tree seedlings (Fulé et al. 1997).

These natural openings appear to have been very important for some species of butterflies, birds, and mammals (Waltz and Covington 2004). Often the largest post-settlement trees, typically a single tree, became established in these natural within-stand openings as soon as herbaceous vegetation was removed by overgrazing (Sánchez Meador et al. 2009). Contemporary within-stand openings or areas dominated by smaller post-settlement trees should be the starting point for restoring more natural within-stand heterogeneity.

Desired Conditions

- The pattern of openings within stands that provide natural spatial heterogeneity for biological diversity are conserved.
- Openings break up fuel continuity to reduce the probability of torching and crowning and restore natural heterogeneity within stands.

- Openings promote snowpack accumulation and retention which benefits groundwater recharge and watershed processes at the fine (1 to 10 acres) scale.
- The presence of such trees does not prevent the reestablishment of sufficient within-stand openings to emulate natural vegetation patterns based on current stand conditions, pre-settlement evidences, desired future conditions, or other restoration objectives.
- Groups of trees typically range in size from 0.1 acre to 1 acre. Canopy gaps and interspaces between tree groups or individuals are based on site productivity and soil type and range from 10 percent on highly productive sites to as high as 90 percent on those soil types that have an open reference condition.
- Suitable openings for successful natural regeneration in this project would range in size from 3/10 to 8/10 of an acre. Openings would be created by focusing on removal of VSS 3 and lower VSS 4, given the excess of such trees across the project area.
- Non-wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 and a mean trees per acre less than 100) would be managed for greater residual canopy cover and density of large trees. Residual stand structure would be managed at the upper end of natural range of variability for ponderosa pine in the non- wildland-urban interface stands that meet these conditions. This would be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes, and/or retaining additional large trees.

Heavily-Stocked Stands (with High Basal Area) Generated by a Preponderance of Large, Young Trees

In some areas, the increase in post-settlement trees has been so rapid that current stand structure is characterized by high density and high basal area in large, young ponderosa pine trees. These stands or groups of stands exhibit continuous canopy which promotes unnaturally severe fire effects under severe fire weather conditions. At the fine scale, the management approach would apply on a case-by-case basis. The cutting of large trees may be necessary to meet site-specific ecological objectives as listed below. For example, the cutting of large trees may be necessary in order to reduce the potential for crown fire to spread into communities or important habitats that include Mexican spotted owl and/or goshawk nest stands. This approach will apply when other options would not alleviate severe fire effects.

In stands where pre-settlement evidences, restoration objectives, community protection, or other ecological restoration objectives indicate much lower tree density and basal area would be desirable, large post-settlement pines may need to be removed to achieve post-treatment conditions consistent with a desired restoration trajectory. Where evidence indicates higher tree density and basal area would have occurred pre-settlement, only a few large pines may need to be removed. Many of these areas would support crown fire and, thus, require structural modification to reduce crown fire potential and restore understory vegetation that supports surface fire.

Desired Conditions

- Natural heterogeneity of forest, savanna, and grasslands occurs at the landscape scale and within stands.
- Groups are restored by retaining the largest trees on the landscape to reestablish old growth structure in the shortest timeframe possible.

- Decreased shading and interception from the canopy, decreased needle litter and duff, and surface fire restore and maintain a mosaic of natural vegetative communities.
- Decreased shading and interception from the canopy fuels allow the growth of continuous herbaceous surface fuels to carry surface fire.
- Reduced horizontal and vertical canopy fuels reduce the potential for crown fire.
- Fire is the principle regulator of forest structure over time.
- Regeneration openings that contribute to the ecological objective of natural heterogeneity of historical forest structure and age class diversity are not encroached upon by trees.
- Non-wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 and a mean trees per acre less than 100) would be managed for greater residual canopy cover and density of large trees. Residual stand structure would be managed at the upper end of natural range of variability for ponderosa pine in the non- wildland-urban interface stands that meet these conditions. This would be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes, and/or retaining additional large trees.

Section E – Density Management and the Relationship Between Treatment Intensity, Tree Group Density, and Overall Average Density

Table D 27. Section E the relationship between treatment intensity, tree group density, and overall average density

Treatment Intensity	Percent of Area		Percent of Treed Area		Average Group basal area (BA) to Achieve Overall BA of:					
	Interspace	Tree	Groups and Individuals	Regeneration	40	50	60	70	80	90
10–25	**10**	**90**	90	0		56	67	78	89	100
			85	5		59	71	82	94	
			80	10		63	75	88	100	
			75	15		67	80	93	107	
			70	20		71	86	100	114	
	15	**85**	85	0		59	71	82	94	106
			80	5		63	75	88	100	
			75	10		67	80	93	107	
			70	15		71	86	100	114	
			65	20		77	92	108	123	
	20	**80**	80	0		63	75	88	100	113
			75	5		67	80	93	107	
			70	10		71	86	100	114	
			65	15		77	92	108	123	
			60	20		83	100	117	133	
25–40	**25**	**75**	75	0		67	80	93	107	120
			70	5		71	86	100	114	
			65	10		77	92	108	123	
			60	15		83	100	117	133	
			55	20		91	109	127	145	
	30	**70**	70	0		71	86	100	114	129
			65	5		77	92	108	123	
			60	10		83	100	117	133	
			55	15		91	109	127	145	
			50	20		100	120	140	160	
	35	**65**	65	0		77	92	108	123	138
			60	5		83	100	117	133	
			55	10		91	109	127	145	
			50	15		100	120	140	160	
			45	20		111	133	156	178	
40–55	**40**	**60**	60	0	67	83	100	117	133	150
			55	5	73	91	109	127	145	

Treatment Intensity	Percent of Area		Percent of Treed Area		Average Group basal area (BA) to Achieve Overall BA of:					
	Interspace	Tree	Groups and Individuals	Regeneration	40	50	60	70	80	90
			50	10	80	100	120	140	160	
			45	15	89	111	133	156	178	
			40	20	100	125	150	175	**200**	
	45	**55**	55	0	73	91	109	127	145	164
			50	5	80	100	120	140	160	
			45	10	89	111	133	156	178	
			40	15	100	125	150	175	**200**	
			35	20	114	143	171	**200**	**229**	
	50	**50**	50	0	80	100	120	140	160	180
			45	5	89	111	133	156	178	
			40	10	100	125	150	175	**200**	
			35	15	114	143	171	**200**	**229**	
			30	20	133	167	**200**	**233**	**267**	
55–70	**55**	**45**	45	0	89	111	133	156		
			40	5	100	125	150	175		
			35	10	114	143	171	**200**		
			30	15	133	167	**200**	**233**		
			25	20	160	**200**	**240**	**280**		
	60	**40**	40	0	100	125	150	175		
			35	5	114	143	171	**200**		
			30	10	133	167	**200**	**233**		
			25	15	160	**200**	**240**	**280**		
			20	20	**200**	**250**	**300**	**350**		
	65	**35**	35	0	114	143	171	**200**		
			30	5	133	167	**200**	**233**		
			25	10	160	**200**	**240**	**280**		
			20	15	**200**	**250**	**300**	**350**		
			15	20	**267**	**333**	**400**	**467**		

BA = basal area

Note: Red fill indicates red stand density index zone for all diameters. Red zone group BA ranges from 125 square feet of basal area for 8 inches quadratic mean diameter to 195square feet of basal area for 24 inches quadratic mean diameter.

TPA by QMD and BA:

	Grp BA																												
Grp QMD	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**	**105**	**110**	**115**	**120**	**125**	**130**	**135**	**140**	**145**	**150**	**155**	**160**	**165**	**170**	**175**	**180**	**185**	**190**	**195**
8	158	172	186	200	215	229	243	258	272	286	301	315	329	344	358														
9	125	136	147	158	169	181	192	204	215	226	238	249	260	272	283	294													
10	101	110	119	128	138	147	156	165	174	183	193	202	211	220	229	238	248	257											
11	83	91	99	106	114	121	129	136	144	152	159	167	174	182	189	197	205	212	220										
12	70	76	83	89	96	102	108	115	121	127	134	140	146	153	159	166	172	178	185	191									
13	60	65	71	76	81	87	92	98	103	109	114	119	125	130	136	141	147	152	157	163	168								
14	51	56	61	66	70	75	80	84	89	94	98	103	108	112	117	122	126	131	136	140	145	150							
15	45	49	53	57	61	65	69	73	77	81	86	90	94	98	102	106	110	114	118	122	126	130							
16	39	43	47	50	54	57	61	65	68	72	75	79	82	86	90	93	97	100	104	107	111	115	118						
17	35	38	41	44	48	51	54	57	60	63	67	70	73	76	79	83	86	89	92	95	98	102	105	108					
18	31	34	37	40	42	45	48	51	54	57	59	62	65	68	71	74	76	79	82	85	88	91	93	96	99				
19	28	31	33	36	38	41	43	46	48	51	53	56	58	61	63	66	69	71	74	76	79	81	84	86	89	91			
20	25	28	30	32	34	37	39	41	43	46	48	50	53	55	57	60	62	64	67	69	71	73	76	78	80	83			
21	23	25	27	29	31	33	35	37	40	42	44	46	48	50	52	54	56	58	60	62	64	67	69	71	73	75	77		
22	21	23	25	27	28	30	32	34	36	38	40	42	44	46	47	49	51	53	55	57	59	61	63	64	66	68	70	72	
23	19	21	23	34	26	28	30	31	33	35	36	38	40	42	43	45	47	49	50	52	54	56	57	59	61	62	64	66	
24	18	19	21	22	24	26	27	29	30	32	33	35	37	38	40	41	43	45	46	48	49	51	53	54	56	57	59	61	62

Color coding key:

Green = SDI zones 1 and 2 (15 to 35% of maximum SDI). This is considered the lower range of stocking.

Yellow = SDI zone 3 (36 to 45% of maximum SDI). This is considered the middle range of stocking.

Orange = SDI zone 3 (46 to 55% of maximum SDI). This is considered the upper range of stocking.

Red = SDI zone 4 (56% + of maximum SDI). Tree groups will not be managed within this zone.

Note: SDI "zones" are explained in the silviculture report.

Figure D 3. Section E density management and stocking guidelines

Section F – Map and Stand List for Management of 46,090 acres

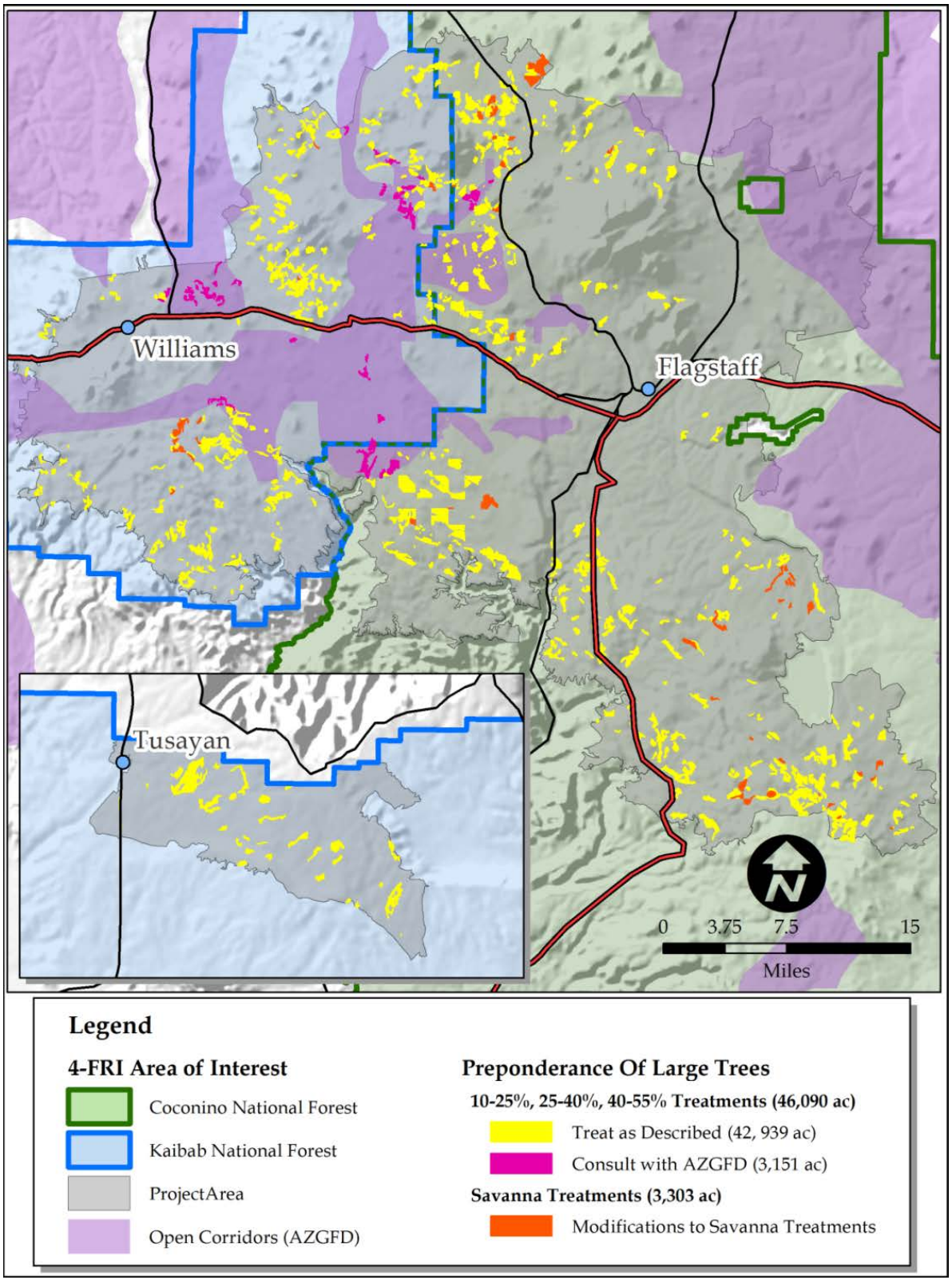

Figure D 4. Map of stands identified with a preponderance of large young trees

Table D 28. List of Stands on the Coconino National Forest in which the design feature applies to the whole stand

Location	Site	Proposed Treatment	Acres	Consult AZGFD
10	8	IT25	65	
15	3	UEA40	99	
15	16	UEA40	21	
15	21	IT40	48	
16	6	IT40	100	
16	15	IT40	15	
16	16	IT40	23	
17	21	UEA40	62	
17	23	UEA40	5	
18	8	IT40	66	
18	15	PFA - UEA40	13	
18	16	UEA40	37	
18	19	PFA - UEA40	3	
19	15	UEA40	96	
19	16	UEA40	71	
22	2	IT40	82	
22	4	UEA40	88	
22	5	PFA - IT40	37	
22	8	UEA40	56	
22	15	UEA40	2	
22	18	PFA - IT40	142	
22	27	UEA40	13	
22	28	PFA - UEA40	7	
22	33	UEA40	10	
22	34	PFA - IT40	47	
22	35	PFA - UEA40	24	
22	46	PFA - UEA40	24	
22	47	PFA - IT40	27	
23	3	UEA40	95	
23	4	IT40	26	
23	5	UEA40	24	
23	9	PFA - UEA40	50	
23	20	UEA40	40	
23	23	UEA40	16	
23	24	IT40	167	
23	25	PFA - UEA40	4	
23	27	PFA - UEA40	9	
23	30	PFA - IT40	24	
24	18	UEA40	4	
27	3	PFA - UEA25	25	
27	4	UEA25	110	
27	7	UEA25	53	
28	1	IT40	60	
28	4	UEA40	108	
28	6	UEA40	24	
28	8	UEA40	89	
28	17	UEA40	20	
28	24	UEA40	66	
28	27	IT25	16	
29	1	UEA10	11	
29	4	UEA40	56	
29	7	UEA40	20	
29	16	UEA40	67	
29	21	IT40	24	
29	25	UEA40	12	
29	43	IT40	22	
30	19	UEA25	64	
30	21	UEA25	5	
30	37	UEA25	15	
30	40	UEA10	16	
30	42	UEA40	21	
30	47	IT40	52	
30	52	IT10	4	
31	4	UEA25	114	
31	6	UEA25	49	
32	5	UEA25	29	
32	8	UEA25	6	
32	9	UEA25	5	
32	12	UEA40	10	
32	14	UEA40	82	
32	22	UEA40	6	
32	23	UEA40	28	
32	35	UEA40	6	
34	27	PFA - IT40	44	
34	29	IT10	25	
34	38	UEA10	91	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
34	40	UEA40	47	
34	45	IT40	102	
35	7	UEA10	7	
35	9	UEA40	16	
35	15	UEA40	3	
36	9	UEA40	2	
36	13	UEA10	2	
36	26	IT10	25	
37	4	UEA25	57	
37	21	UEA10	38	
37	25	UEA10	44	
37	28	PFA - UEA10	47	
38	12	UEA40	83	
38	19	UEA40	8	
38	22	UEA10	<0.5	
38	34	dPFA - UEA10	21	Yes
39	14	UEA40	75	
39	25	UEA40	3	
39	28	UEA40	29	
39	56	UEA10	7	
39	59	UEA10	47	
39	64	dPFA - UEA40	21	
40	3	UEA10	2	
41	15	PFA - UEA10	9	
41	16	PFA - UEA10	2	
41	17	UEA10	30	
41	18	UEA10	98	
43	1	IT40	7	
43	4	UEA10	5	
43	7	IT40	21	
43	8	IT40	77	
43	10	IT40	86	Yes
43	23	UEA10	10	
44	5	UEA10	1	
44	14	UEA40	59	Yes
44	22	dPFA - IT40	121	
44	24	dPFA - UEA40	2	
44	25	dPFA - UEA40	36	
44	26	dPFA - UEA40	87	
44	33	UEA40	38	
44	34	IT40	161	Yes
44	37	dPFA - UEA40	57	Yes
44	39	IT40	9	Yes
44	40	dPFA - UEA10	28	
44	44	UEA40	8	
45	25	IT40	62	
52	13	UEA10	12	
53	1	IT40	9	
53	2	UEA40	42	
53	8	IT10	2	
53	9	IT40	3	
53	10	IT40	14	
53	13	IT40	17	
53	16	UEA40	3	
53	17	IT40	20	
53	18	UEA40	1	
53	26	UEA40	60	
53	27	IT40	109	
53	31	IT40	17	
57	2	UEA10	3	
57	3	UEA10	3	
57	4	IT10	14	
58	4	UEA40	15	
58	9	UEA40	51	
58	17	IT40	99	
58	20	UEA40	7	
59	6	IT40	242	
59	8	UEA40	18	
59	11	UEA40	14	
59	16	IT40	21	
59	24	UEA40	24	
59	27	IT40	81	
60	6	IT40	74	
60	14	IT40	7	
60	15	IT40	6	
60	18	UEA40	13	
60	22	IT40	2	
60	23	UEA40	0	
60	26	PFA - IT40	1	
60	36	UEA40	15	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
60	39	UEA25	5	
60	49	UEA10	3	
60	53	IT40	2	
60	55	IT40	33	
60	63	IT40	24	
60	65	IT40	26	
65	29	PFA - UEA40	26	
66	12	UEA40	50	
66	26	UEA40	59	
67	3	UEA40	135	
67	8	UEA40	127	
67	10	IT40	159	
76	2	UEA10	147	
76	3	IT10	101	
77	8	IT10	6	
77	10	UEA40	47	
77	15	UEA10	196	
77	18	PFA - UEA10	30	
78	10	IT40	92	
78	15	UEA40	51	
78	20	IT40	76	
78	31	IT40	27	
83	7	UEA10	7	
83	8	IT10	4	
84	1	IT40	94	
84	25	UEA10	17	
85	15	UEA10	63	
86	11	UEA40	40	
86	27	PFA - IT10	56	
86	28	UEA10	64	
87	1	UEA10	136	
87	3	UEA40	13	
87	5	UEA25	9	
87	15	IT10	49	
87	19	UEA40	129	
87	21	IT40	29	
87	22	UEA40	31	
87	23	IT25	31	
90	12	IT40	46	
90	14	UEA40	122	
90	19	IT25	14	
91	14	UEA10	21	
91	22	UEA10	178	
91	29	UEA25	4	
93	9	UEA25	6	
94	5	IT10	102	
95	5	dPFA - UEA10	52	
95	10	UEA10	4	
95	11	UEA40	34	
95	13	IT10	66	
95	18	dPFA - UEA10	14	
95	19	UEA25	34	
95	23	dPFA - UEA10	13	
99	20	UEA10	24	
128	3	IT40	40	Yes
128	4	IT10	134	Yes
128	5	UEA40	57	Yes
129	6	IT10	56	Yes
130	4	UEA40	21	
130	5	UEA40	1	
130	15	UEA40	10	
130	26	UEA40	5	
131	8	UEA40	15	
131	9	UEA40	20	
131	10	UEA40	5	
131	17	UEA40	11	
131	18	UEA40	24	
131	23	UEA40	224	
131	36	UEA40	4	
140	2	dPFA - IT40	45	
140	4	IT40	91	Yes
140	7	dPFA - UEA10	69	
140	14	dPFA - IT10	55	Yes
141	3	IT10	172	Yes
141	5	UEA40	130	
141	6	UEA40	374	
141	12	IT10	21	Yes
142	5	UEA40	56	
142	16	IT40	15	
142	17	UEA40	91	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
143	2	IT40	56	
143	4	UEA40	24	
143	8	UEA25	47	
143	15	UEA40	65	
143	21	UEA40	17	
150	3	IT40	12	
150	4	UEA40	40	
150	5	UEA40	11	
150	6	IT40	221	
150	12	IT40	165	
151	3	IT40	27	
153	4	PFA - IT40	50	
153	9	IT40	64	
153	28	UEA10	19	
153	33	IT40	40	
154	7	UEA40	19	
154	12	UEA25	8	
154	15	IT40	13	
154	16	UEA40	7	
154	17	UEA40	99	
154	18	UEA40	50	
155	1	dPFA - UEA25	209	
155	5	IT40	138	
157	12	IT40	9	
160	15	UEA10	2	
160	16	IT40	54	
161	2	UEA40	5	
161	5	IT40	8	
161	7	IT10	24	
161	15	UEA40	69	
161	17	UEA40	8	
161	19	UEA40	15	
161	20	UEA40	7	
161	23	IT40	25	
161	27	IT40	40	
162	1	IT10	56	
162	2	IT40	40	
162	3	IT10	6	
162	4	IT10	9	
162	12	UEA40	6	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
162	15	UEA10	2	
162	18	IT40	4	
162	21	UEA40	35	
162	27	IT40	17	
163	5	IT40	82	
163	6	IT40	213	
164	1	IT40	82	
164	4	UEA40	190	
167	4	IT40	58	
167	8	UEA40	3	
167	14	UEA40	127	
167	15	IT40	37	
167	43	IT10	58	
168	1	IT40	80	
168	4	IT40	6	
168	13	IT40	35	
169	16	UEA10	22	
169	19	UEA40	4	
169	22	UEA40	26	
170	3	UEA40	49	
170	6	PFA - IT40	34	
170	7	UEA25	2	
173	12	UEA40	20	
176	22	UEA10	79	
176	24	UEA40	39	
178	19	UEA10	151	
179	3	UEA40	417	
179	4	IT40	92	
179	5	IT40	186	
179	23	UEA40	119	
181	5	IT10	4	
208	3	UEA25	26	
208	4	UEA10	6	
208	8	UEA10	18	
208	12	IT10	62	
208	13	IT25	146	
208	16	UEA40	23	
209	2	UEA25	43	
209	6	UEA25	20	
209	10	UEA25	11	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
210	12	UEA40	63	
218	5	UEA10	138	
218	17	UEA10	29	
218	22	PFA - UEA10	24	
219	11	UEA10	70	
219	12	UEA10	30	
229	6	UEA25	205	
229	29	SI25	22	
277	9	PFA - UEA25	30	
277	10	PFA - IT25	9	
277	13	PFA - IT10	7	
277	15	PFA - UEA10	30	
277	16	PFA - UEA10	36	
277	19	PFA - UEA10	40	
277	31	PFA - UEA10	3	
277	33	PFA - UEA10	5	
277	35	IT10	28	
277	36	PFA - IT10	7	
277	37	PFA - UEA10	3	
279	4	UEA10	40	
314	4	UEA25	45	
314	17	UEA40	42	
315	6	UEA25	39	
315	12	UEA25	49	
344	12	UEA25	18	
344	13	UEA25	13	
344	15	UEA40	15	
345	4	IT25	57	
345	11	UEA25	30	
345	19	UEA40	64	
345	34	UEA10	30	
345	36	UEA10	21	
345	47	IT40	6	
345	48	UEA10	6	
345	49	UEA10	25	
345	50	UEA10	22	
350	28	UEA40	18	
354	15	UEA10	98	
354	17	UEA40	53	
354	20	UEA40	13	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
354	30	UEA10	21	
355	2	UEA40	129	
355	3	UEA40	17	
363	7	UEA25	82	
368	4	IT40	155	
368	8	UEA40	8	
368	17	UEA40	17	
368	21	IT40	82	
368	38	IT40	11	
369	10	UEA40	35	
369	12	IT40	105	
374	2	UEA40	91	
374	12	UEA25	34	
375	1	UEA40	60	
375	16	UEA40	11	
376	6	UEA25	149	
376	9	UEA40	33	
382	6	UEA40	4	
382	8	IT40	94	
383	4	UEA40	7	
383	9	UEA40	70	
383	16	UEA40	16	
387	14	IT40	24	
390	2	UEA40	21	
391	6	UEA40	110	
391	10	UEA40	9	
393	8	UEA25	63	
393	13	UEA10	42	
393	22	UEA25	38	
393	34	IT10	11	
395	7	UEA40	98	
396	24	UEA40	28	
396	30	IT40	72	
396	32	IT40	76	
398	20	UEA40	23	
399	23	dPFA - IT40	7	
400	11	UEA40	12	
400	22	IT40	161	
400	24	UEA40	26	
406	1	IT40	182	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
409	5	UEA25	37	
409	6	UEA10	20	
410	28	UEA40	42	
411	7	UEA40	25	
411	10	UEA40	57	
411	29	UEA40	117	
412	2	UEA40	36	
412	4	UEA10	78	
412	6	UEA25	56	
412	15	UEA40	16	
413	5	UEA40	39	
414	1	UEA40	101	
416	1	dPFA - IT40	65	
416	9	IT40	68	
423	5	UEA40	51	
423	8	UEA25	58	
423	9	UEA25	54	
423	11	UEA25	20	
423	13	UEA10	73	
423	14	UEA10	36	
424	13	UEA25	24	
424	19	UEA40	39	
424	27	UEA40	29	
425	10	UEA40	17	
425	11	UEA40	37	
425	13	UEA40	119	
426	16	PFA - IT40	84	
426	27	UEA40	26	
429	6	UEA40	79	
441	8	UEA25	16	
442	9	IT40	106	
452	24	UEA40	28	
452	25	UEA40	25	
453	4	UEA10	25	
458	8	UEA10	15	
459	1	UEA25	93	
459	3	PFA - UEA10	31	
459	7	UEA25	104	
460	16	UEA10	116	
472	7	UEA40	44	
472	8	UEA40	16	
473	2	UEA10	231	
473	8	IT40	54	
473	15	UEA10	27	
473	17	UEA10	13	
475	6	UEA25	31	
475	9	UEA10	82	
475	10	UEA10	25	
475	14	UEA10	79	
476	17	UEA40	71	
478	5	IT40	12	
478	9	IT40	7	
478	16	IT40	16	
480	14	IT40	167	
480	21	IT25	45	
482	2	UEA40	16	
482	13	UEA40	30	
486	7	IT40	81	
486	28	UEA40	21	
492	1	UEA40	93	
492	9	UEA40	32	
496	31	UEA25	116	
497	20	PFA - UEA40	33	
499	16	IT40	34	
499	17	UEA10	64	
499	23	IT40	31	
499	25	PFA - UEA40	24	
500	13	UEA40	51	
501	2	PFA - UEA25	9	
501	5	IT40	61	
501	6	UEA10	41	
501	7	UEA10	71	
501	11	UEA40	47	
501	12	UEA40	15	
501	13	IT40	23	
501	17	IT40	38	
501	18	UEA40	33	
502	13	IT10	39	
502	14	IT25	36	
502	17	IT25	62	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
502	19	UEA40	54	
502	20	IT40	43	
502	22	UEA40	27	
502	24	IT40	74	
502	26	IT40	33	
502	27	UEA40	86	
502	30	UEA25	10	
503	1	UEA10	77	
503	5	UEA40	8	
503	9	IT10	142	
503	11	IT40	140	
504	2	UEA40	167	
505	7	IT40	118	
505	13	IT40	125	
506	4	IT40	54	
511	8	UEA40	20	
512	3	UEA10	80	
512	4	UEA40	180	
513	11	IT40	22	
513	14	PFA - IT40	44	
514	21	UEA40	87	
515	11	UEA40	11	
516	5	IT10	26	
516	12	IT40	75	
516	22	UEA40	26	
516	23	IT40	58	
517	13	IT40	69	
517	21	PFA - IT10	73	
517	23	UEA40	52	
519	3	UEA10	69	
520	4	UEA25	128	
522	2	UEA10	296	
524	3	UEA40	20	
526	1	IT10	28	
526	28	UEA40	34	
527	3	UEA40	12	
527	5	UEA10	23	
527	6	IT40	13	
527	8	IT40	29	
527	10	UEA25	8	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
527	11	IT25	53	
527	13	IT25	12	
527	14	IT25	32	
527	18	IT40	31	
527	19	IT40	74	
527	20	IT40	35	
527	21	UEA40	35	
527	23	IT25	48	
527	24	UEA10	57	
527	25	IT40	46	
527	26	IT25	70	
527	27	IT25	15	
527	30	IT40	98	
527	31	IT25	35	
527	34	IT25	22	
528	2	IT40	37	
528	3	IT40	18	
528	6	IT25	19	
528	8	IT40	17	
530	8	UEA40	24	
531	2	UEA10	61	
531	4	IT40	10	
540	4	UEA10	57	
540	8	UEA40	45	
540	10	IT40	45	
540	33	IT40	31	
540	40	UEA10	22	
540	41	UEA40	82	
540	42	UEA40	63	
545	3	IT40	60	
545	4	IT40	95	
545	5	UEA40	36	
545	13	UEA10	26	
545	14	IT40	60	
545	17	IT10	15	
545	19	UEA10	83	
545	20	UEA40	26	
545	22	IT10	92	
545	24	IT10	101	
545	25	IT10	47	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
546	1	IT25	93	
546	10	IT40	11	
546	14	UEA40	74	
547	3	UEA40	29	
548	5	UEA40	35	
548	12	IT40	36	
548	13	UEA10	49	
548	22	IT40	62	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
549	1	IT40	3	
549	13	UEA10	10	
553	3	IT40	77	
702	22	UEA40	51	
704	16	UEA40	36	
934	5	UEA40	40	
937	17	UEA40	35	
1216	1	UEA40	7	

Table D 29. List of Stands on the Coconino National Forest in which the design feature applies to portions of a stand

Location	Site	Proposed Treatment	Acres	Total Stand Acres	Consult AZGFD
29	6	IT40	43	64	
34	4	UEA40	92	105	
38	4	dPFA - UEA40	31	52	
38	36	dPFA - IT40	50	58	
39	65	UEA40	15	114	
86	29	IT40	21	145	
93	8	IT40	91	173	
128	6	UEA40	172	708	Yes
229	28	PFA - SI25	37	59	
277	3	UEA40	22	62	
314	9	UEA40	15	23	
350	10	UEA25	37	50	
395	2	IT40	0	115	
395	15	IT40	47	109	
404	30	UEA40	30	33	
471	5	PFA - IT40	24	167	
473	16	UEA25	77	91	
481	9	PFA - IT40	51	91	
496	23	UEA40	64	89	
515	9	UEA40	180	219	

Table D 30. List of stands on the Kaibab National Forest in which the design feature applies to the whole stand

Location	Site	Proposed Treatment	Acres	Consult AZGFD
1504	63	UEA25	31	
1513	23	PFA - UEA10	42	
1513	27	PFA - UEA10	88	
1513	33	PFA - UEA25	55	Yes
1513	35	PFA - UEA40	22	Yes
1523	40	IT40	7	
1523	54	UEA40	53	
1523	79	UEA40	28	
1524	5	IT40	5	
1526	29	UEA40	14	
1527	1	IT40	40	
1527	19	UEA40	38	
1527	47	PFA - UEA40	33	
1528	39	IT40	64	
1531	9	PFA - IT40	21	
1531	42	PFA - UEA40	23	
1532	5	UEA40	38	
1532	11	UEA40	31	
1532	15	UEA25	18	
1532	18	IT40	24	
1532	19	UEA40	24	
1532	20	IT25	51	
1532	25	IT40	7	
1534	7	IT40	15	
1534	9	UEA40	69	
1534	17	IT40	52	
1534	55	IT40	57	
1534	57	UEA25	9	
1538	3	UEA40	27	
1538	7	UEA40	10	
1538	38	UEA40	4	
1539	3	UEA40	38	
1539	4	UEA10	18	
1539	7	UEA40	26	
1539	10	UEA10	24	
1539	15	IT40	10	
1539	18	UEA40	33	
1539	27	IT40	1	
1540	4	UEA40	102	
1542	16	UEA25	36	
1542	22	UEA40	57	
1545	14	UEA40	40	
1545	38	IT40	159	
1545	44	UEA40	20	
1545	52	IT40	149	
1545	58	UEA40	15	
1549	23	UEA25	61	
1549	26	IT40	72	
1550	9	UEA40	177	
1550	19	UEA25	47	
1550	20	IT25	52	
1550	22	UEA25	14	
1550	30	UEA40	29	
1551	18	IT40	17	
1551	19	UEA25	26	
1551	24	UEA40	35	
1551	25	UEA40	30	
1551	27	UEA40	88	
1551	28	UEA25	20	
1551	30	UEA40	16	
1551	31	UEA40	33	
1551	38	UEA25	3	
1551	122	UEA40	93	
1551	124	UEA10	14	
1551	131	UEA40	19	
1552	2	IT40	46	
1552	135	UEA25	16	
1554	1	UEA40	104	
1554	8	UEA40	66	
1555	20	UEA40	59	
1556	12	UEA40	19	
1556	14	UEA40	14	
1556	114	UEA40	9	
1558	1	UEA40	11	
1558	5	IT40	9	
1558	6	UEA40	15	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
1558	11	UEA40	96	
1558	14	UEA40	37	
1558	16	UEA40	86	
1558	24	IT40	36	
1559	29	UEA25	14	
1559	101	UEA40	7	
1560	16	IT40	21	
1560	31	UEA40	22	
1564	30	UEA40	24	
1564	42	UEA40	116	
1564	56	UEA25	22	
1573	21	UEA40	40	
1573	39	UEA40	43	
1574	25	UEA40	38	
1575	1	dPFA - UEA40	35	
1575	12	UEA40	27	
1575	23	UEA40	4	
1577	8	UEA40	37	
1579	33	UEA40	31	
1580	1	IT10	62	
1580	17	UEA40	32	
1614	2	PFA - IT40	55	
1618	7	UEA40	38	
1618	39	UEA40	72	
1622	45	UEA40	14	
2212	24	PFA - UEA40	29	
2214	3	UEA40	21	
2214	9	IT40	13	
2214	14	PFA - UEA40	26	
2214	17	PFA - UEA10	16	
2214	20	UEA10	25	
2215	14	UEA40	40	Yes
2218	2	UEA40	30	
2218	3	UEA40	28	
2218	5	IT25	27	
2218	39	UEA40	103	
2219	5	PFA - UEA25	69	
2219	36	PFA - UEA25	46	
2219	40	UEA25	134	
2220	26	UEA25	66	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
2221	8	UEA40	36	
2221	13	UEA40	23	
2221	18	UEA25	89	
2221	22	PFA - UEA25	15	
2221	36	IT40	44	
2221	44	UEA25	6	
2222	1	UEA25	19	
2222	2	UEA25	10	
2222	14	UEA40	23	
2222	15	UEA40	175	
2223	4	UEA40	24	
2224	3	UEA40	14	
2224	10	UEA40	132	
2225	19	UEA25	14	
2225	21	UEA10	24	
2225	27	PFA - UEA40	54	
2225	30	UEA25	62	
2225	32	UEA40	8	
2225	42	PFA - UEA40	12	
2225	45	UEA40	45	
2225	49	UEA40	6	
2225	52	UEA40	7	
2225	60	PFA - UEA40	11	
2225	61	PFA - UEA40	42	
2226	8	PFA - UEA40	8	
2226	14	UEA40	29	
2226	23	UEA40	29	
2227	9	PFA - UEA25	11	
2227	20	UEA40	17	
2227	49	UEA40	23	
2227	52	UEA40	16	
2230	43	UEA40	36	
2230	46	UEA40	39	
2230	65	UEA40	13	
2230	68	UEA10	28	
2230	69	UEA10	40	
2230	73	UEA10	29	
2230	82	PFA - UEA25	12	
2231	18	UEA40	50	
2231	23	UEA10	27	Yes

Location	Site	Proposed Treatment	Acres	Consult AZGFD
2231	24	UEA40	25	
2232	6	UEA10	56	
2234	3	IT10	24	
2234	8	IT40	13	
2234	9	IT10	23	
2234	15	UEA25	18	
2234	17	IT10	27	
2235	1	IT40	42	
2235	2	UEA40	42	
2235	3	UEA10	39	
2235	6	UEA40	19	
2235	11	IT40	26	
2236	6	IT40	27	
2236	11	UEA25	78	
2236	13	UEA25	27	Yes
2236	15	IT40	36	
2236	16	UEA40	19	
2237	12	UEA10	15	Yes
2237	23	UEA40	27	
2237	24	UEA40	11	
2237	27	UEA40	21	
2237	29	UEA25	8	
2238	18	UEA40	49	
2238	22	UEA25	80	Yes
2238	23	PFA - IT40	116	
2241	8	UEA25	52	
2241	13	UEA10	81	
2241	14	PFA - UEA10	26	
2241	17	UEA40	15	
2241	18	UEA25	32	
2241	20	UEA25	43	
2241	21	UEA25	77	
2241	28	UEA10	11	
2242	5	UEA25	27	
2242	18	UEA25	50	
2242	25	UEA40	41	
2242	28	UEA25	25	
2242	33	IT25	64	
2242	39	UEA40	83	
2242	43	UEA40	17	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
2243	6	UEA10	65	
2243	12	UEA40	22	
2243	35	UEA40	90	
2243	54	UEA25	7	
2243	56	UEA25	34	
2243	81	UEA10	30	
2245	10	UEA40	17	
2245	12	UEA10	30	
2245	14	UEA10	11	
2245	16	UEA10	25	
2245	17	UEA25	26	
2245	18	IT25	16	
2245	28	UEA25	59	
2245	32	IT40	31	
2245	34	UEA40	41	
2245	40	IT25	16	
2245	46	PFA - UEA10	25	
2246	29	UEA40	10	
2247	3	UEA25	35	
2247	13	UEA10	25	
2247	14	UEA25	88	
2247	24	UEA40	65	
2247	26	UEA10	8	
2247	28	UEA10	32	
2247	29	IT10	7	
2247	102	UEA10	15	
2247	103	UEA10	13	
2248	4	UEA40	11	
2248	5	UEA40	56	
2248	16	UEA40	51	
2254	25	IT40	7	
2254	41	UEA40	44	
2254	48	UEA40	46	
2255	4	UEA40	34	
2255	10	UEA40	15	
2256	23	IT40	73	Yes
2256	34	UEA40	18	Yes
2256	39	UEA25	37	
2256	41	UEA40	32	Yes
2256	42	UEA40	28	Yes

Location	Site	Proposed Treatment	Acres	Consult AZGFD
2256	45	UEA40	44	
2256	47	IT40	66	Yes
2256	84	UEA40	49	Yes
2256	87	UEA40	24	Yes
2256	90	IT40	25	Yes
2257	3	IT10	24	Yes
2257	4	UEA40	101	Yes
2258	15	UEA10	19	Yes
2258	16	IT40	31	Yes
2258	17	UEA40	37	Yes
2258	24	IT40	34	Yes
2258	25	UEA40	24	Yes
2258	26	IT40	32	Yes
2258	27	IT40	27	
2258	29	UEA40	34	
2258	30	UEA40	60	
2258	32	UEA40	18	Yes
2258	43	UEA40	32	
2258	44	UEA40	38	
2258	45	UEA40	37	
2258	52	UEA40	52	
2258	103	UEA25	26	Yes
2259	1	IT40	39	
2260	33	UEA10	19	
2260	39	IT40	26	
2261	21	IT40	48	
2261	73	UEA25	32	
2263	1	UEA10	20	
2263	2	UEA40	40	
2263	15	UEA40	40	
2263	17	IT40	43	
2263	18	UEA40	23	
2263	20	IT40	26	
2263	27	UEA40	25	
2263	30	UEA40	25	
2263	55	UEA40	30	
2263	57	PFA - UEA10	26	
2264	28	UEA40	49	
2264	32	dPFA - UEA40	18	
2264	49	IT40	42	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
2264	51	UEA10	8	
2264	64	UEA40	159	
2265	5	UEA40	48	
2265	10	UEA40	50	
2265	26	UEA40	55	
2265	34	IT40	1	
2266	8	IT40	66	
2266	11	UEA40	65	
2266	22	UEA40	22	
2266	23	UEA40	5	
2266	38	UEA40	8	
2266	47	UEA40	22	
2266	50	UEA40	70	
2266	53	UEA10	14	
2266	65	UEA40	121	
2266	73	UEA40	20	
2267	1	IT40	17	
2267	2	IT40	21	
2267	4	UEA40	15	
2267	10	UEA40	28	
2267	11	UEA40	8	
2267	12	UEA40	41	
2267	13	UEA40	98	
2267	14	UEA40	75	
2267	35	UEA10	16	
2267	37	UEA40	83	
2267	39	UEA40	32	
2267	43	UEA40	21	
2267	47	UEA10	37	
2267	48	UEA10	10	
2267	49	UEA10	26	
2267	50	UEA25	69	
2267	52	UEA25	48	
2267	53	UEA40	26	
2267	58	UEA40	24	
2267	59	UEA40	7	
2267	60	UEA10	5	
2267	61	UEA40	6	
2267	62	UEA40	13	
2267	68	IT25	24	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
2267	75	UEA40	26	
2267	104	UEA10	43	
2268	9	UEA40	59	Yes
2269	19	UEA40	45	Yes
2269	26	UEA40	39	Yes
2269	32	UEA10	27	Yes
2269	33	UEA40	19	Yes
2269	34	UEA10	22	Yes
2269	35	UEA40	22	Yes
2269	53	IT40	27	Yes
2269	58	IT40	25	Yes
2269	59	UEA40	38	Yes
2270	6	IT40	40	Yes
2270	8	IT40	35	Yes
2270	10	UEA40	28	Yes
2270	13	UEA25	68	Yes
2270	29	UEA40	21	Yes
2273	1	UEA40	10	
2273	22	UEA40	16	
2274	6	UEA40	20	Yes
2274	8	UEA40	40	
2274	12	UEA10	23	Yes
2278	6	UEA40	28	Yes
2278	9	UEA40	97	Yes
2284	8	UEA10	22	
2285	19	UEA40	11	Yes
2285	21	PFA - UEA40	24	Yes
2285	24	PFA - UEA40	30	Yes
2285	25	PFA - UEA40	19	Yes
2285	28	UEA10	20	Yes
2285	49	IT40	15	Yes
2285	50	UEA40	22	Yes
2285	51	UEA40	39	
2285	52	UEA40	41	
2285	53	UEA40	26	
2285	55	UEA40	53	
2285	61	UEA25	17	
2294	7	PFA - UEA40	13	
2294	32	UEA25	45	
2294	37	UEA40	43	
2294	40	UEA40	23	
2295	2	UEA40	47	
2295	3	UEA40	78	
2295	9	UEA40	66	
2295	10	UEA40	40	
2295	15	UEA40	42	
2295	23	UEA40	16	
2296	13	UEA25	39	
2296	16	UEA25	35	
2296	17	IT25	30	
2296	20	UEA40	56	
2296	21	UEA25	22	
2296	23	UEA40	38	
2296	25	IT40	100	
2296	28	UEA40	114	
2296	30	IT40	46	
2296	38	UEA40	20	
2296	39	UEA40	12	
2297	22	IT40	108	
2297	23	UEA40	48	
2297	24	UEA40	59	
2297	25	UEA25	8	
2297	26	UEA40	38	
2297	27	UEA40	66	
2297	34	UEA40	23	
2298	16	UEA10	30	
2298	22	UEA10	21	
2298	25	UEA40	15	
2299	28	dPFA - UEA40	68	
2304	36	UEA40	26	
2320	49	UEA40	21	
2323	23	UEA25	36	Yes
2323	33	UEA40	13	Yes
2323	34	IT40	71	Yes
2323	36	UEA25	12	Yes
2323	39	IT40	18	Yes
4055	8	UEA25	69	
4055	13	UEA25	80	
4057	16	UEA40	6	
4058	2	UEA40	45	

Location	Site	Proposed Treatment	Acres	Consult AZGFD
4058	13	UEA40	6	
4083	2	UEA25	40	
4085	3	dPFA - IT25	25	
4085	12	dPFA - UEA25	23	
4085	19	dPFA - UEA25	8	
4085	23	UEA25	20	
4086	16	UEA25	26	
4087	5	UEA25	44	
4087	15	dPFA - UEA40	38	
4087	18	dPFA - UEA40	23	
4088	8	UEA25	135	
4089	22	UEA25	17	
4090	6	UEA25	12	
4090	11	UEA25	75	
4091	13	dPFA - UEA40	84	
4092	2	PFA - IT10	33	
4094	19	UEA40	87	
4095	9	UEA10	65	
4095	13	dPFA - UEA25	7	
4095	17	UEA25	15	
4097	11	UEA25	45	
4097	14	IT25	38	
4097	19	UEA25	116	
4101	4	UEA25	49	
4101	14	PFA - UEA25	14	
4108	37	UEA25	2	
4108	44	PFA - UEA25	13	
4108	54	UEA25	14	
4109	2	UEA40	183	
4109	8	UEA25	24	
4109	31	UEA25	20	
4109	32	IT25	7	
4210	10	UEA40	5	

Table D 31. List of Stands on the Kaibab National Forest in which the design feature applies to portions of a stand

Location	Site	Proposed Treatment	Acres	Total Stand Acres	Consult AZGFD
1538	9	UEA40	33	46	
1539	33	UEA10	23	65	
1545	46	UEA40	13	86	
1574	30	UEA40	11	59	
1618	62	UEA40	16	43	
2236	10	IT25	41	41	
2248	25	UEA25	28	29	
2260	21	PFA - UEA40	31	57	
2260	26	UEA25	54	98	
2277	11	IT40	85	99	Yes
2277	31	UEA40	49	87	Yes
2294	5	IT40	28	52	
2294	9	PFA - UEA25	25	28	
2298	7	IT40	18	50	
2299	1	IT40	42	49	
2304	21	UEA40	8	26	
4055	5	dPFA - UEA25	216	253	
4055	5	UEA25	36	253	
4055	10	dPFA - UEA25	106	329	
4055	10	UEA25	222	329	
4099	4	UEA25	25	28	
4210	8	IT40	40	60	

Attachment 1: Potential Implications of 4FRI Large/Mature Tree Retention on Corridors for Grassland Wildlife

Prepared by S. Rosenstock and J. Gist, Arizona Game and Fish Dept., Region II Habitat Program, 12/15/14

Background

Rapid population growth and associated development have impacted many native wildlife species in Arizona. One landscape-scale consequence of those changes is reduction in habitat connectivity for ungulates and other highly mobile terrestrial species. This loss of connectivity can prevent access to important habitat resources, limit gene flow, and ultimately effect population viability and persistence. The American Pronghorn (*Antilocapra americana*) is a species for which connectivity is of primary importance and whose habitats in northern Arizona have been adversely impacted by a variety of factors, including encroachment of woody vegetation into mid-elevation grasslands and meadows/openings within the ponderosa pine cover type.

Historically, pronghorn maintained genetic connectivity from the South Rim of the Grand Canyon to the Prescott Valley. Today, a combination of roads, impermeable fences, encroached meadows and forests, and other barriers impede their seasonal migrations and daily movements. The Arizona Game and Fish Department (Department) has aggressively pursued partnership efforts to reconnect pronghorn populations across Northern Arizona. These include cooperative studies with the Arizona Department of Transportation and Federal Highways Administration to identify animal movements, and use these data to facilitate safe crossing of transportation corridors while protecting human safety. The Department is also working with private landowners and public lands managers to retrofit fences for passage by pronghorn and other wildlife. As a cooperating agency for the 4FRI EIS, the Department worked closely with the ID Team to identify places where treatments could be strategically placed to benefit pronghorn and other grassland species. These included savannah/grassland restoration areas and movement corridors located within forested areas. The latter were identified through a multi-stakeholder, collaborative connectivity assessment for Coconino County (Arizona Game and Fish Department. 2011. The Coconino County Wildlife Connectivity Assessment: Report on Stakeholder Input).

Treatment elements intended to benefit grassland species were vetted through the 4FRI stakeholder group and included in the initial treatment design (DEIS). Unfortunately, the selected Alternative C did not carry these forward in full. Approximately 9,800 acres of stands targeted for retention of mature/old-growth and large, young trees (VSS 4-6) and higher levels of canopy cover fall within grassland species movement corridors identified in the 2011 connectivity assessment (Figure 1). Within those stands, the Department has identified approximately 2,500 acres that represent potential high-priority areas for creation or enhancement of connectivity for pronghorn and other open-canopy species. Examples of such areas are given in Figures 2 and 3.

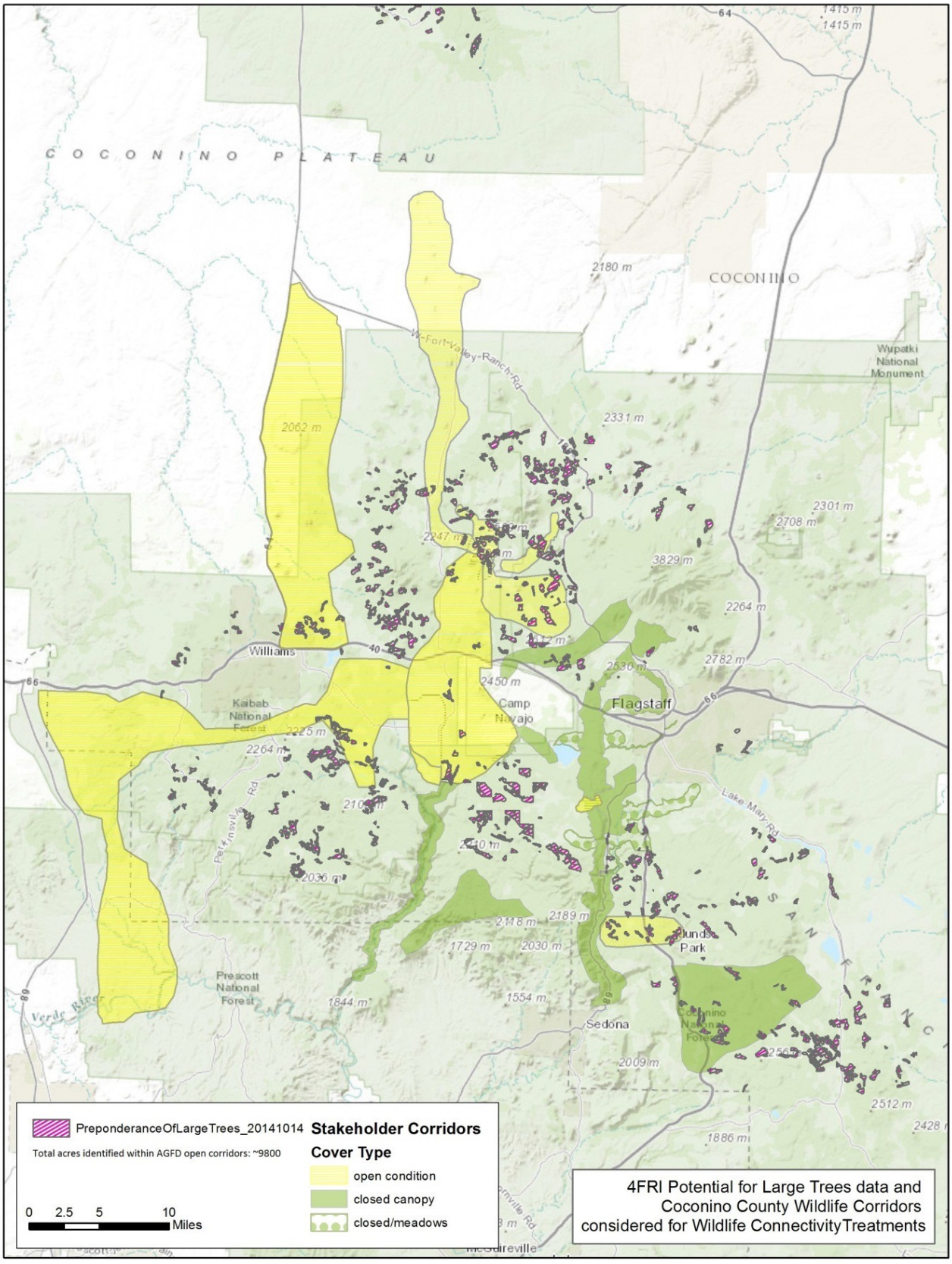

Figure 1. Locations of wildlife movement corridors and VSS 4, 5, 6 retention stands located therein

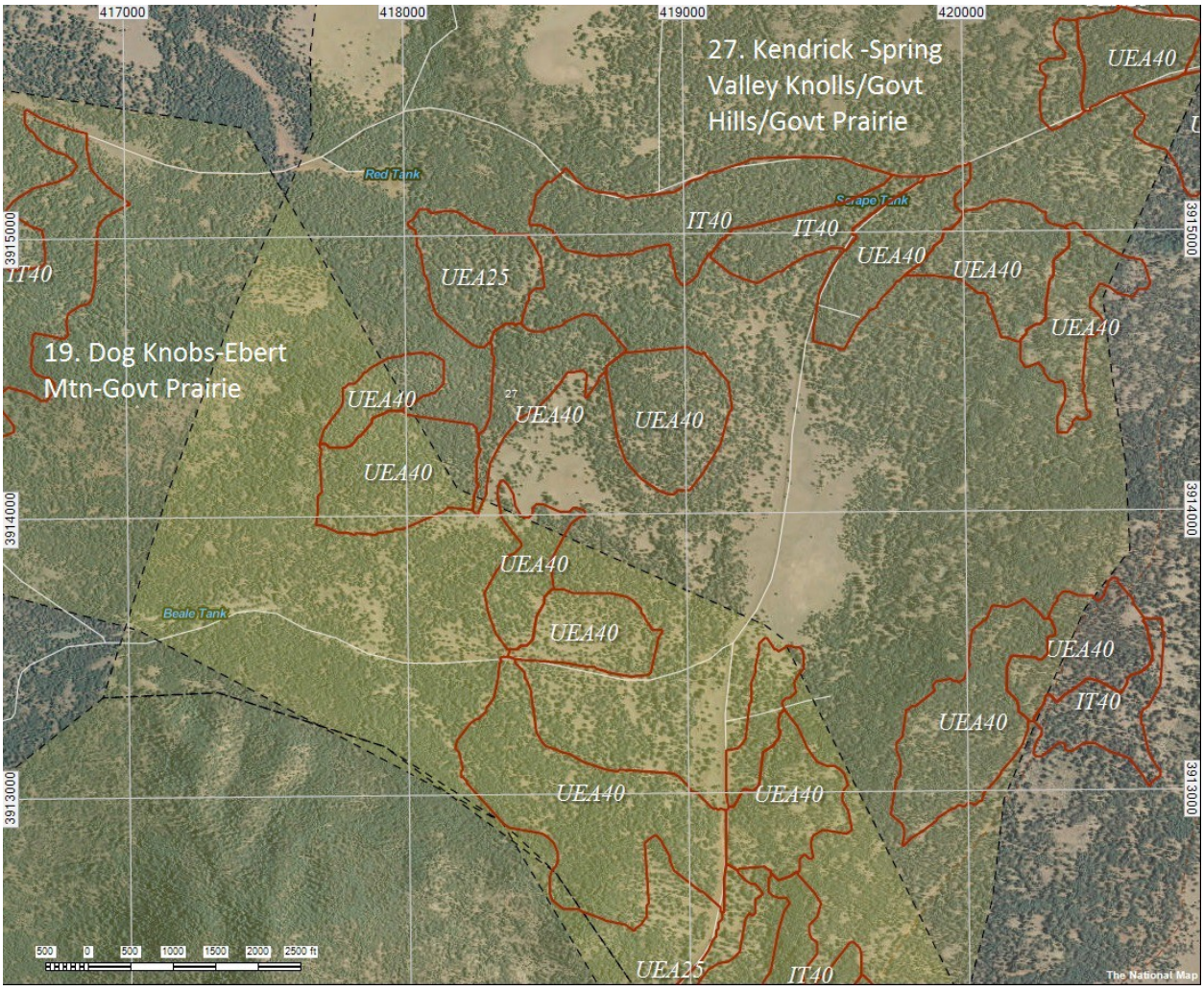

Figure 2. Current satellite imagery showing example grassland wildlife corridors (within dashed lines) that are blocked by large/mature tree retention stands (orange polygons, labeled by treatment type)

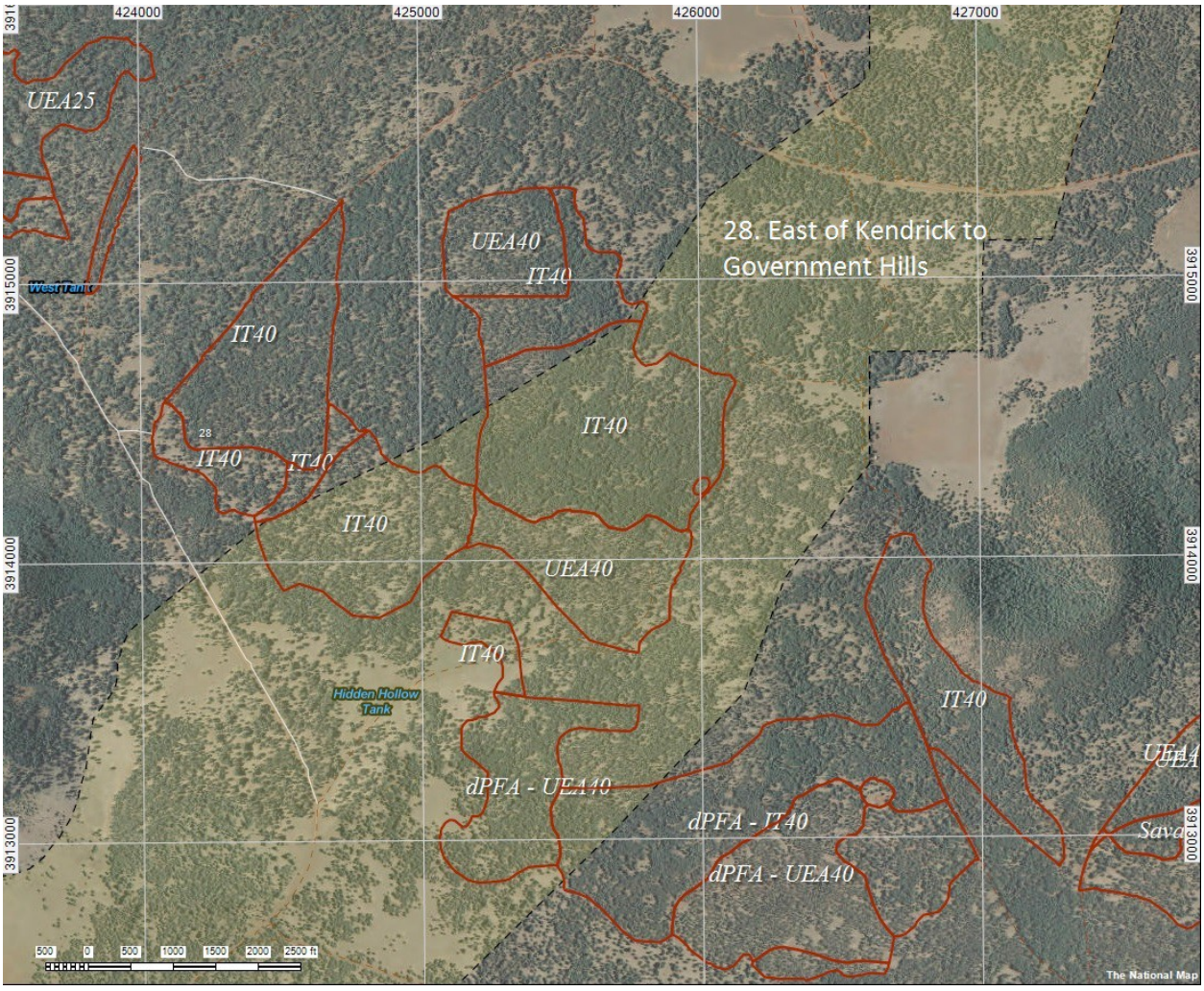

Figure 3. Current satellite imagery showing example grassland wildlife corridors (within dashed lines) that are blocked by large/mature tree retention stands (orange polygons, labeled by treatment type)

We are concerned that strict implementation of the Alternative C treatment design will compromise our ability to meet important conservation objectives for grassland wildlife and miss opportunities to leverage work being done under 4FRI. Where large tree retention objectives overlap with identified grassland-species movement corridors, we recommend adding language to the ROD and Implementation Plan that provide flexibility for more intense mechanical treatment under limited and clearly defined circumstances. This would allow removal of conifers from encroached meadows, restoration and connection of forest openings, and creation of travel corridors through stands with high tree densities. Our expectation is that few, if any of these modifications would impact stands composed of mature or old-growth trees, instead falling into those with a preponderance of large, young trees. It's important to note that delineation of retention stands was based on USFS stand exam data, which are relatively coarse with respect to the scale at which mechanical treatment would be used to create/modify movement corridors.

Actual conditions on the ground may differ, thus the actual number of acres affected could be lower. During implementation, corridor treatments will be informed by existing and future data on pronghorn movements, including that obtained from pronghorn recently capture and collared by the Department.

Suggested Modifications

We suggest the following potential additions to support restoration and enhancement of grassland wildlife corridors through mechanical treatments implemented during 4FRI (DROD, pp. 21-22)

> *In addition, the implementation plan (FEIS, appendix D) now emphasizes that when outside of the wildland-urban interface, restoration treatments in goshawk habitat (approximately 38,260 acres) will focus on the removal of small-diameter trees and will emphasize retaining large trees where applicable to move toward deficit stand structure. This will be accomplished by placing an emphasis on creating regeneration openings and interspace in areas where smaller VSS 3 and VSS 4 trees dominate. The placement of tree groups to be retained will focus on areas where the largest trees are already aggregated. These groups will generally range between 0.25 and 1 acre in size. This will result in stands being composed of groups of larger trees intermixed with relatively small openings. In stands with a preponderance of large young trees the treatment intensity will be managed to the lower end of the available spectrum. Management in these stands still recognizes the need to create regeneration openings to be able to promote uneven- aged stand conditions.*
>
> *The selected alternative also recognizes that, within the savanna treatment acres, there are some stands that contain a preponderance of large, young trees. On the 3,300 acres where this occurs, we have decided to use the treatments proposed in alternative E that will retain large trees and not implement savanna treatments on these acres.*
>
> **Suggested Additional Text:** Within the above areas, there would be limited exceptions for more intensive mechanical treatment in areas previously identified as corridors for grassland wildlife (AGFD 2011), that would not exceed approximately 2,500 acres across the entire analysis area. Old growth trees would not be cut under this exception.

(FEIS Appendix D – Alternatives B through E Implementation Plan)

Landscapes Outside of Goshawk Post-fledging Areas, WUI55, UEA40, UEA25 and UEA10 Mechanical Thin and Burn Treatments Design

On approximately 23,500 acres (about 12,200 acres on the Coconino and 11,300 acres on the Kaibab NF, respectively) of uneven-aged (UEA) 40 and UEA 25 non- wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 of the VSS4 size class and a mean trees per acre less than 100 of the VSS 4 size class) would be managed for greater residual canopy cover and density of large trees. Residual stand structure would be managed at the upper end of natural range of variability for ponderosa pine in the non- wildland-urban interface stands that meet these conditions. This would be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees. Post treatment canopy cover in these stands would meet or exceed forest plan guidance for canopy cover, and is intended to achieve 40 percent canopy cover at the stand scale (alternative C and E only).

Suggested Additional Text: Limited exceptions could occur on areas identified as potential movement corridors for pronghorn and other grassland wildlife species (see AGFD 2011). In those areas, more intensive mechanical thinning of non-old-growth trees and lower levels of residual canopy cover would be allowed. These would be of limited spatial extent and intended to restore natural openings, increase connectivity between natural openings, and facilitate animal movement through treed areas.

Landscapes Outside of Goshawk Post-fledging Areas Intermediate Thin (IT) 40, 25, and 10 Mechanical Thin and Burn Treatments Design

On approximately 11,600 acres (about 8,900 acres on the Coconino and 2,700 acres on the Kaibab NF, respectively) of IT 40 and IT 25 non-wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 of the VSS4 size class and a mean trees per acre less than 100 of the VSS 4 size class) would be managed for greater residual canopy cover and density of large trees. Residual stand structure would be managed at the upper end of natural range of variability for ponderosa pine in the non- wildland-urban interface stands that meet these conditions. This would be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees. Post treatment canopy cover in these stands would meet or exceed forest plan guidance for canopy cover, and is intended to achieve 40 percent canopy cover at the stand scale (alternative C and E only).

Suggested Additional Text: Limited exceptions could occur on areas identified as potential movement corridors for pronghorn and other grassland wildlife species (see AGFD 2011). In those areas, more intensive mechanical thinning of non-old-growth trees and lower levels of residual canopy cover would be allowed. These would be of limited spatial extent and intended to restore natural openings, increase connectivity between natural openings, and facilitate animal movement through treed areas.

Savanna/Grassland Restoration Mechanical and Burn Treatments Design

In alternatives B-D only, restore pre-settlement tree density and pattern using pre-settlement evidence as guidance. Manage for an open reference condition with 10 to 30 percent of the area under ponderosa pine and deciduous tree crowns (see forest plan consistency evaluation in silviculture report).

Suggested Additional Text: Manage for the sustainability of identified wildlife corridors for grassland species (see AGFD 2011) by treating these areas to the higher end of percent in interspaces or to a lower ratio of leave tree to evidence ratio.

Dispersal Post-fledging Family Areas / Post-fledging Family Areas in Uneven-aged Treatment (UEA) Types 40, 25, and 10 Mechanical Thin and Burn Treatments Design

On approximately 2,000 acres (about 700 acres on the Coconino and 1,300 acres on the Kaibab) of dispersal post-fledging family area UEA 25, dispersal post-fledging family area UEA 40, post- fledging family area UEA 25 and post-fledging family area UEA 40 non- wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 of the VSS4 size class and a mean trees per acre less than 100 of the VSS 4 size class) would be managed for greater residual canopy cover and density of large trees. Residual stand structure would be managed at the upper end of natural range of variability for ponderosa pine in the non-wildland-urban interface stands that meet these conditions. This would be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees. Post treatment canopy cover in these stands would meet or exceed forest plan guidance for canopy cover, and is intended to achieve for mid-aged forest (VSS 4) on average 1/3 60+ percent and 2/3 50+ percent and for mature (VSS 5) and old forest (VSS 6) should average 50+ percent canopy cover at the stand scale (alternative C and E only).

Suggested Additional Text: Limited exceptions could occur on areas identified as potential movement corridors for pronghorn and other grassland wildlife species (see AGFD 2011). In those areas, more intensive mechanical thinning of non-old-growth trees and lower levels of residual canopy cover would be allowed. These would be of limited spatial extent and intended to restore natural openings, increase connectivity between natural openings, and facilitate animal movement through treed areas.

Dispersal Post-fledging Family Areas / Post-fledging Family Areas Intermediate Thin (IT)40, 25 and 10 Mechanical Thin and Burn Treatments Design

On approximately 1,100 acres (about 900 acres on the Coconino and 200 acres on the Kaibab) of dispersal post-fledging family areas IT 25, dispersal post-fledging family areas IT 40, post- fledging family areas IT 25 and post-fledging family areas IT 40 stands that are not wildland- urban interface with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 of the VSS4 size class and a mean trees per acre less than 100 of the VSS 4 size class) would be managed for greater residual canopy cover and density of large trees. Residual stand structure would be managed at the upper end of natural range of variability for ponderosa pine in the non- wildland-urban interface stands that meet these conditions. This would be accomplished by focusing treatments towards the lower end of the

identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees. Post treatment canopy cover in these stands would meet or exceed forest plan guidance for canopy cover, and is intended to achieve for mid-aged forest (VSS 4) on average 1/3 60+ percent and 2/3 50+ percent and for mature (VSS 5) and old forest (VSS 6) should average 50+ percent canopy cover at the stand scale (alternative C and E only.

Suggested Additional Text: Limited exceptions could occur on areas identified as potential movement corridors for pronghorn and other grassland wildlife species (see AGFD 2011). In those areas, more intensive mechanical thinning of non-old-growth trees and lower levels of residual canopy cover would be allowed. These would be of limited spatial extent and intended to restore natural openings, increase connectivity between natural openings, and facilitate animal movement through treed areas.

Dispersal Post-fledging Family Areas / Post-fledging Family Areas Stand Improvement (SI)40, 25, and 10 Mechanical Thin and Burn Treatments Design

On approximately 37 acres (about 37 acres on the Coconino) of post-fledging family area SI 25 non- wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 of the VSS4 size class and a mean trees per acre less than 100 of the VSS 4 size class) would be managed for greater residual canopy cover and density of large trees. Residual stand structure would be managed at the upper end of natural range of variability for ponderosa pine in the non-wildland-urban interface stands that meet these conditions. This would be accomplished by focusing treatments towards the lower end of the identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees. Post treatment canopy cover in these stands would meet or exceed forest plan guidance for canopy cover, and is intended to achieve for mid- aged forest (VSS 4) on average 1/3 60+ percent and 2/3 50+ percent and for mature (VSS 5) and old forest (VSS 6) should average 50+ percent canopy cover at the stand scale (alternative C and E only).

Suggested Additional Text: Limited exceptions could occur on areas identified as potential movement corridors for pronghorn and other grassland wildlife species (see AGFD 2011). In those areas, more intensive mechanical thinning of non-old-growth trees and lower levels of residual canopy cover would be allowed. These would be of limited spatial extent and intended to restore natural openings, increase connectivity between natural openings, and facilitate animal movement through treed areas.

Dispersal Post-fledging Family Areas / Post-fledging Family Areas Pine Sage Mechanical and Burn Treatment Design

On approximately 87 acres (about 87 acres on the Kaibab NF) of post-fledging family areas pine sage non- wildland-urban interface stands with a preponderance of large trees (at a minimum all VSS 5 and 6 stands and VSS 4 stands with a mean basal area greater than 70 of the VSS4 size class and a mean trees per acre less than 100 of the VSS 4 size class) would be managed for greater residual canopy cover and density of large trees. Residual stand structure would be managed at the upper end of natural range of variability for ponderosa pine in the non-wildland-urban interface stands that meet these conditions. This would be accomplished by focusing treatments towards the lower end of

the identified intensity range, managing for larger group sizes (see below), and/or retaining additional large trees. Post treatment canopy cover in these stands would meet or exceed 40 percent, measured at the stand scale (alternative C and E only).

Suggested Additional Text: Limited exceptions could occur on areas identified as potential movement corridors for pronghorn and other grassland wildlife species (see AGFD 2011). In those areas, more intensive mechanical thinning of non-old-growth trees and lower levels of residual canopy cover would be allowed. These would be of limited spatial extent and intended to restore natural openings, increase connectivity between natural openings, and facilitate animal movement through treed areas.

Attachment 2: Site-Specific Location Sites for Upper-Diameter Limit Treatments within Mechanical Treatment Mexican Spotted Owl Protected Activity Centers

The following displays the location site and upper diameter limit for treatment for proposed mechanical treatment areas within MSO PACs. Note that treatments of trees greater than 14 inches d.b.h. will be treated according to the resolution agreement with Wild Earth Guardians.

Archies

Table D 32. Stands by Diameter Limit in Archies PAC

Location	Site	Acres
Up to 8.9" d.b.h.		
402	13	148
417	07	33
418	03	193
418	05	22
418	07	48
Up to 11.9" d.b.h.		
418	06	41
Up to 13.9" d.b.h.		
418	02	11

Bar M

Table D 33. Stands by Diameter Limit in Bar M PAC

Location	Site	Acres
Up to 8.9" d.b.h.		
496	29	15
496	30	12
497	04	28
497	11	35
497	21	28
Up to 11.9" d.b.h.		
496	09	59
496	27	75
497	14	15
Up to 13.9" d.b.h.		
496	28	69
497	02	47
497	03	20
497	06	35
497	13	27
Up to 15.9" d.b.h.		
497	05	43
497	12	23

Bear Seep

Table D 34. Stands by Diameter Limit in Bear Seep PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
444	04	136
444	20	112
453	01	44
453	02	160
Up to 15.9" d.b.h.		
444	05	144
Up to 17.9" d.b.h.		
444	13	10

Bonita Tank

Table D 35. Stands by Diameter Limit in Bonita Tank PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
413	04	37
Up to 11.9" d.b.h.		
397	07	80
398	04	29
398	21	95
Up to 13.9" d.b.h.		
397	09	34
397	10	3
397	13	182
398	03	80
413	08	57
415	01	73
Up to 17.9" d.b.h.		
398	05	122
415	11	5

Crawdad

Table D 36. Stands by Diameter Limit in Crawdad PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
399	08	54
399	12	55
399	28	29
Up to 13.9" d.b.h.		
398	23	40
399	06	35
399	07	8
399	09	38
399	10	122
399	11	46
399	22	3
399	26	11
400	27	40
Up to 15.9" d.b.h.		
389	11	62
400	13	37
Up to 17.9" d.b.h.		
399	27	21

Foxhole

Table D 37. Stands by Diameter Limit in Foxhole PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
496	10	10
Up to 11.9" d.b.h.		
496	09	117
497	09	7
Up to 13.9" d.b.h.		
477	29	80
484	14	25
496	08	31
Up to 15.9" d.b.h.		
484	15	23
496	02	41
496	04	9
496	07	57
497	01	49

Frank

Table D 38. Stands by Diameter Limit in Frank PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
500	10	100
513	01	14
513	04	13
513	08	47
513	17	12
513	20	82
516	26	19
Up to 11.9" d.b.h.		
513	03	11
516	25	58
Up to 13.9" d.b.h.		
513	05	54
513	07	27
513	19	73
513	21	24
Up to 15.9" d.b.h.		
500	31	19
Up to 17.9" d.b.h.		
513	02	33

Holdup

Table D 39. Stands by Diameter Limit in Holdup PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
399	20	17
400	29	39
Up to 11.9" d.b.h.		
399	19	170
400	02	27
Up to 13.9" d.b.h.		
390	06	90
390	07	16
399	14	31
400	01	26
400	04	86
400	30	14
Up to 15.9" d.b.h.		
400	28	18

Iris Tank

Table D 40. Stands by Diameter Limit in Iris Tank PAC

Location	Site	Acres
Up to 8.9" d.b.h.		
485	10	25
485	12	49
499	05	54
500	15	21
500	34	23
Up to 11.9" d.b.h.		
500	36	13
Up to 13.9" d.b.h.		
485	02	29
485	07	60
485	08	27
485	11	35
499	02	46
499	03	33
500	16	31
Up to 15.9" d.b.h.		
500	01	14
500	02	34
Up to 17.9" d.b.h.		
485	09	18
485	15	9
499	01	62
500	18	13

Knob

Table D 41. Stands by Diameter Limit in Knob PAC

Location	Site	Acres
Up to 8.9" d.b.h.		
461	13	31
461	16	78
474	01	83
933	06	75
934	06	5
Up to 11.9" d.b.h.		
934	07	26
Up to 13.9" d.b.h.		
474	03	138
475	11	68
476	01	35
933	08	11
Up to 15.9" d.b.h.		
461	06	47
474	02	67

Lake 1/Seruchos

Table D 42. Stands by Diameter Limit in Lake 1/Seruchos PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
371	02	29
372	02	94
Up to 11.9" d.b.h.		
372	01	66
Up to 13.9" d.b.h.		
371	01	50

Lee Butte

Table D 43. Stands by Diameter Limit in Lee Butte PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
523	07	19
523	10	15
523	14	46
523	18	12
523	19	19
Up to 11.9" d.b.h.		
523	17	1
Up to 13.9" d.b.h.		
523	04	54
523	08	62
523	21	12
Up to 17.9" d.b.h.		
523	13	67

Mayflower Tank

Table D 44. Stands by Diameter Limit in Mayflower Tank PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
453	03	52
453	09	12
454	11	59
454	14	10
454	15	22
454	17	25
454	18	53
454	23	8
464	06	16
Up to 13.9" d.b.h.		
453	08	87
454	21	52
Up to 15.9" d.b.h.		
453	10	38
454	27	45
464	05	35
Up to 17.9" d.b.h.		
464	15	99

Red Hill

Table D 45. Stands by Diameter Limit in Red Hill PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
160	07	31
160	09	5
160	25	45
160	27	16
Up to 11.9" d.b.h.		
153	07	25
153	15	134
153	18	32
Up to 13.9" d.b.h.		
153	14	63
160	04	53
160	06	102
160	18	108
160	26	58

Red Raspberry

Table D 46. Stands by Diameter Limit in Red Raspberry PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
430	10	112
431	05	44
431	06	56
431	11	111
431	13	30
431	16	35
Up to 11.9" d.b.h.		
431	09	19
Up to 13.9" d.b.h.		
430	06	35
431	08	0
431	10	107
431	14	60
Up to 15.9" d.b.h.		
431	03	55
Up to 17.9" d.b.h.		
431	12	8
431	15	8

Rock Top

Table D 47. Stands by Diameter Limit in Rock Top PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
514	14	58
514	17	4
515	07	12
515	08	24
Up to 11.9" d.b.h.		
498	10	57
Up to 13.9" d.b.h.		
514	18	115
515	01	61
515	02	17
515	05	115
515	06	99
515	16	51
523	03	47
Up to 15.9" d.b.h.		
515	18	40
523	02	51

Sawmill Springs

Table D 48. Stands by Diameter Limit in Sawmill Springs PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
541	13	58
541	16	65
541	19	12
547	01	58
Up to 11.9" d.b.h.		
541	17	63
Up to 13.9" d.b.h.		
531	07	66
540	24	21
547	08	93
547	10	9
Up to 17.9" d.b.h.		
541	14	18
547	09	53

T6 Tank

Table D 49. Stands by Diameter Limit in T6 Tank PAC

Location	Site	Acres
Up to 8.9” d.b.h.		
462	01	15
462	07	73
477	35	15
477	36	22
Up to 11.9" d.b.h.		
477	30	27
477	37	31
477	39	19
496	32	38
Up to 13.9" d.b.h.		
462	05	22
477	32	52
477	33	12
477	40	30
477	43	25
496	03	33
933	04	35
933	05	40
933	07	30
Up to 15.9" d.b.h.		
462	02	52
477	41	20
Up to 17.9" d.b.h.		
477	28	69
477	38	19