Appendix D – Alternative B Through D Implementation Plan

The environmental impact statement (EIS) describes the purpose and need, alternatives and the effects of managing the 4FRI project area. This implementation plan is designed to be integral to the selected alternative and record of decision (ROD). The process described in this appendix describes the linkage from the EIS to the project specific work without the need for additional NEPA analysis. It must be considered in conjunction with appendix C that provides the design criteria, best management practices, and mitigation measures. Table 112 to table 115 are checklists designed to ensure compliance with the analysis, decision, and other requirements. Essentially, if the quantity of treatments in table 112 and table 113 by resource unit are within the bounds of the treatments analyzed in chapter 3 of the EIS and the specialist's reports, then the program of work is considered to be consistent with the effects analysis.

Table 114 and table 115 show the compliance evaluation and documentation requirements to also demonstrate this compliance. Sections A through E provide direction that would be used by implementation personnel to ensure that implementation meets the purpose and need and forest plan standards and guidelines. It is the foundation for the formal silvicultural prescriptions. The silvicultural prescriptions will document the desired conditions presented in the analysis, incorporate design features and mitigation (appendix C), and provide the course of action needed to move toward those desired conditions.

Description of Plan Components

Table 112: Annual Implementation Checklist. The checklist is designed to track compliance with the NEPA decision and ensure activities are consistent and compliant with the analysis and decision (correct location, appropriate number of acres by treatment type). The checklist is designed to be used by the implementation team leader. Sources of data to populate row three are found in chapter 3 and the specialists reports.

Table 113: Planned Acres by Treatment Type and Restoration Unit (RU). The checklist is designed to facilitate accomplishment reporting. The checklist is designed to be used (at a minimum) by the implementation team leader and forest program managers. Sources of data to populate row three are found in chapter 3 and the specialists reports.

Table 114: NEPA, NFMA, ESA, CFLR Act Compliance Evaluation. The checklist is designed to ensure resource surveys are completed as required by the forest plan, policy, U.S. Fish and Wildlife Service (FWS) biological opinion, Comprehensive Forest Landscape Restoration Act (CFLR), or other requirements. The checklist also ensures that the site-specific treatments are compliant with the NEPA analysis and decision. The checklist is designed to be used by the resource specialists who comprise the implementation team and by the Agency's (delegated) approving official.

Table 115: Supporting Documentation. This checklist is designed to ensure required plans and surveys are tracked annually and are readily accessible to the implementation team and approving official. It will be used in combination with appendix E that shows the adaptive management strategy.

Section A: This section includes existing forest plan management direction, desired conditions, and treatment specific silvicultural design. It is designed to be used by the project silviculturist and implementation team.

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

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

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

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

Table 112. Annual implementation checklist

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

Table 113. Planned acres by treatment type and restoration unit (RU)

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

Acre/Miles by Treatment Type to be Implemented in this Phase	RU1	RU3	RU4	RU5	RU6
Savanna (70 to 90% interspace)					
Stand Improvement (SI) 10 (10 to 25% interspace)					
Stand Improvement (SI) 25 (25 to 40% interspace)					
Stand Improvement (SI) 40 (40 to 55% interspace)					
Uneven-aged (UEA) 10 (10 to 25% interspace)					
Uneven-aged (UEA) 25 (25 to 40% interspace)					
Uneven-aged (UEA) 40 (40 to 55% interspace)					
Wildland-Urban Interface (WUI) Pinyon-juniper					
Wildland-Urban Interface (WUI) 55					
Pile Burning					
Broadcast Burning					
Jackpot Burning					
Fire Line Construction					

Acre/Miles by Treatment Type to be Implemented in this Phase		RU1	RU3	RU4	RU5	RU6
Existing System and Unauthorized Road Decommission						
Temporary Road Construction						
Temporary Road Decommission						
Road Reconstruction/Relocation						
Springs	Remove Trees to Pre-settlement Condition					
	Remove Noxious Weeds					
	Prescribed Fire					
	Protective Measures					
Ephemeral Channels	Reestablish Drainage, Slopes, Vegetation					
	Site Protection					
	Remove or Rehab Stock Tanks					
	Other					
Construct Protective Fencing: Springs/Aspen						
Are acres proposed for treatments in this phase within the limits authorized in the decision?		**Yes_____No_____**				

Table 114. NEPA, NFMA, ESA, CFLR Act compliance evaluation

Compliance Evaluation	Yes	No	Not Applicable
Is the project within the maximum treatment acres identified in the NEPA decision?			
Is treatment design consistent with desired conditions, design criteria, and mitigation?			
Are wildlife and botanical surveys, if necessary, complete? Is the action consistent with the FWS biological opinion dated_____?			
Are heritage surveys complete? Is the action consistent with the letter of concurrence form the AZ SHPO dated_____?			
Have contacts with tribal representatives been made?			
Are rights-of-way and land line locations in place (if applicable)?			
Are treatments consistent with the Old Tree Implementation Plan (Section C)			
Has the monitoring and adaptive management plan been evaluated to document compliance with law, regulation, policy, and forest plans?			
Have additional implementation and effectiveness monitoring needs been identified?			
As required by CFLR Act, is multiparty monitoring underway?			
Are adaptive management actions being proposed? If so, clearly analyzed and covered by the decision made?			
Has the administrator checklist been completed and signed by the appropriate resource specialists?			
Is the treatment (burn) plan completed and signed? • Objectives have been developed in interdisciplinary manner and are clearly delineated? • Objectives are consistent with management direction? • Objectives match those described for RU in NEPA analysis? Complexity rating_____			
Do conditions match those described in NEPA analysis? Examples where conditions have changed: New listed species in project area; New invasive species in project area; Change in regulations Burn/treatment plan doesn't allow implementing design criteria	YES___ ___	NO____ ___	
Have issues identified in the NEPA analysis been reviewed?			
Has a post-implementation review been completed (may be filled out after approval)?			
Alternative C Only: Are treatments consistent with Large Tree Implementation Plan? (Section D)			

Table 115. Supporting documentation checklist

Document Name	Attached? Y/N
Silviculture Prescriptions	
Burn Plan	
Transportation Safety Plan	
Wildlife Surveys	
Botany Surveys	
Archaeological Surveys	
Monitoring Results	

Project Resource Specialist Review

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

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

Approving Official

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

Agency Approving Official, Title **Date**

ATTACHMENTS: (add to as necessary)

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

MSO Habitat

Protected Activity Center (PAC)

Vegetation Management Direction: Retain key forest species such as oak; retain key habitat components such as snags and large down logs; harvest conifers less than 9 inches in diameter only within those PACs treated to abate fire risk and avoid treatment in 100-acre nest cores as described in the MSO recovery plan. Further 4FRI guidelines include the primary objective of improving MSO habitat when mechanically treating PACs potentially cutting trees greater than 9-inch d.b.h.

Desired Conditions: Table III.B.1 (USDI 1995) lists guidance for minimum desired structural elements within PACs. This includes 150 square feet of basal area (BA), 30 percent or more of the SDI in ponderosa pine trees ≥18-inch d.b.h., 15 percent or more of the stand density index in ponderosa pine trees between 12- and 18-inch d.b.h., ≥20 trees per acre ≥18-inch d.b.h., and ≥20 Gambel oak BA. Other key habitat components includes snags 18 inches plus, down logs >12-inch midpoint diameter, hardwoods, and an understory vegetation layer that includes shrubs and herbaceous species.

PAC Mechanical Thin and Burn Treatment Design

Each PAC has 100-acre no treatment area around the known nest or roost sites.

Outside the 100-acre no treatment area, trees may be thinned and/or prescribed burns may be used to treat fuels and mitigate fuel hazards where feasible.

Each PAC to be thinned would have an upper diameter limit of trees that may be cut. All trees above that limit would be retained.

Intermediate thinning would be used to increase residual tree health and vigor and reduce fire hazard.

Manage for 150 square feet of BA where present or to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density in alternatives B and D. In alternative C, manage for a minimum of 110 square feet of BA where present or to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density.

Manage for irregular tree spacing to create canopy gaps and other structural conditions that would be conducive to low intensity prescribed fire treatment.

Manage for the sustainability of individual/isolated old ponderosa pine trees as defined in the old tree implementation strategy by reducing crown competition and increasing growing space adjacent to these trees. Remove ponderosa pine trees up to the treatment diameter limit that do not meet the old tree definition and whose crowns are outside the old tree crown drip line (1) within a 50-foot radius that are in the intermediate or suppressed crown positions and (2) that would eliminate direct crown competition on two of the four sides of the old tree.

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch diameter at root collar

(drc) or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

Gambel oak, juniper, and pinyon species will not be cut as part of the treatments. These species may only be cut when there is no other option to facilitate logging operations (skid trails and landings).

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height and reducing litter/duff cover and other surface fuel loading. Prescribed fires are designed to maintain and enhance desired MSO PAC habitat forest structure, tree densities, snag densities, and CWD levels.

PAC Burn Only Treatment Design

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

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

Prescribed fires are designed to maintain and enhance desired MSO PAC habitat forest structure, tree densities, snag densities, and CWD levels.

Steep Slopes

Vegetation Management Direction: Treat fuel accumulations to abate fire risk. Use combinations of thinning trees less than 9 inches in diameter, mechanical fuel removal, and prescribed fire; retain woody debris larger than 12 inches in diameter, snags, clumps of broad-leafed woody vegetation, and hardwood trees larger than 10-inch drc.

Desired Conditions: Table III.B.1 (USDI 1995) lists structural elements. Other key habitat components includes snags 18 inches plus, down logs >12-inch midpoint diameter, hardwoods, and an understory vegetation layer that includes shrubs and herbaceous species.

Steep Slopes Burn Only Treatment Design

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

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

Prescribed fires are designed to maintain and enhance desired MSO protected forest structure, tree densities, snag densities, and CWD levels.

Restricted Habitat (Table 116)

Definition: Pine-oak – ponderosa pine habitat type series; within the Gambel oak or Gambel oak phase of the habitat type; ≥10 percent of the stand BA or 10 square feet per acre of BA consists of Gambel oak ≥5 inches drc.

General Vegetation Management Direction: Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Habitat variables are documented in table III.B.1 of the MSO recovery plan (USDI 2012). Management would attempt to mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes. Allow natural canopy gap processes to occur, thus producing horizontal variation in stand structure. Emphasize uneven-aged management systems. Both even-aged and uneven-aged systems may be used where appropriate to provide variation in existing stand structure and species diversity. Save all trees greater than 24-inch d.b.h. Retain existing large oaks and promote growth of additional large oaks. Encourage prescribed fire to reduce hazardous fuel accumulation. Retain substantive amounts of key habitat components (snags 18 inches plus, down logs >12-inch midpoint diameter, and hardwoods).

Table 116. MSO restricted habitat target/threshold conditions for pine-oak forests

Stand Averages	
BA	≥150 BA
18-inch + trees/acre (TPA)	≥20
Oak BA (square feet)	≥20 BA
Percent Total Existing SDI by Size Class	
12–18″	≥15
18–24″	≥15
24+″	≥15

Threshold Habitat

Vegetation Management Direction: Stand averages currently meet or exceed threshold values in table III.B.1 of the MSO recovery plan. Management would not reduce variables below the threshold values.

Desired Conditions: Irregular tree spacing and various patch size. Horizontal variation in stand structure. Other key habitat components includes snags 18 inches plus, down logs >12-inch midpoint diameter, and hardwoods.

Threshold Mechanical Thin and Burn Treatment Design

Intermediate thinning would be used to increase residual tree health and vigor and reduce fire hazard.

Manage for ≥150 square feet of BA where present, with a portion of those acres ≥170 square feet of BA in alternatives B and D. In alternative C, manage for a minimum 110 square feet of BA and

manage for ≥ 150 square feet of BA where present in areas with site potential capable of sustaining high tree density.

Manage to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density in all alternatives.

Manage for irregular tree spacing to create canopy gaps and other structural conditions that would be conducive to low intensity prescribed fire treatment.

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

No trees larger than 24-inch d.b.h. would be cut.

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

Gambel oak, juniper, and pinyon species will not be cut as part of the treatments. These species may only be cut when there is no other option to facilitate logging operations (skid trails and landings).

Snags would be managed for two per acre ≥18 inches and at least 30 feet in height, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches and a minimum of 8 feet in length.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height and reducing litter/duff cover and other surface fuel loading. Prescribed fires are designed to maintain and enhance desired MSO restricted threshold habitat forest structure, tree densities, snag densities, and CWD levels.

Threshold Burn Only Treatment Design

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

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

Prescribed fires are designed to maintain and enhance desired MSO restricted threshold habitat forest structure, tree densities, snag densities, and CWD levels.

Target

Vegetation Management Direction: Stand averages currently meet or exceed some threshold values in table III.B.1 of the MSO recovery plan. Management would not reduce variables that are currently at or above the threshold value below the threshold values. Management would encourage development of threshold values that are lacking.

Desired Conditions: Irregular tree spacing and various patch size. Horizontal variation in stand structure. Other key habitat components include snags 18 inches plus, down logs greater than 12 inches midpoint diameter, and hardwoods.

Target Mechanical Thin and Burn Treatment Design

Intermediate thinning would be used to increase residual tree health and vigor and reduce fire hazard.

Manage for 150 square feet of BA where present or to attain 150 square feet of BA in areas with site potential capable of sustaining high tree density in alternatives B and D. In alternative C, manage for a minimum 110 square feet and manage for ≥ 150 square feet of BA where present in areas with site potential capable of sustaining high tree density.

Manage for irregular tree spacing to create canopy gaps and other structural conditions that would be conducive to low intensity prescribed fire treatment.

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

No trees larger than 24-inch d.b.h. would be cut.

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

Gambel oak, juniper, and pinyon species will not be cut as part of the treatments. These species may only be cut when there is no other option to facilitate logging operations (skid trails and landings).

Snags would be managed for two per acre ≥18 inches and at least 30 feet in height, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches and a minimum of 8 feet in length.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height and reducing litter/duff cover and other surface fuel loading.

Prescribed fires are designed to maintain and enhance desired MSO restricted target habitat forest structure, tree densities, snag densities, and CWD levels.

Target Burn Only Treatment Design

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

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

Prescribed fires are designed to maintain and enhance desired MSO restricted target habitat forest structure, tree densities, snag densities, and CWD levels.

Restricted Other (Table 117)

Vegetation Management Direction: Current stand averages meet few of the threshold values in table III.B.1 of the MSO recovery plan (USDI 2012). Management would encourage development of threshold values that are lacking.

Desired Conditions: Uneven aged (3-plus age classes). Irregular tree spacing and various patch size. Horizontal variation in stand structure. Other key habitat components includes snags 18 inches plus, down logs >12-inch midpoint diameter, and hardwoods.

Restricted Other Mechanical Thin and Burn Treatment Design

Uneven age thinning and group selection would be used to establish interspace between tree groups, thin tree groups, and create regeneration openings.

Treatments would strive to attain the following overall average density and structural characteristics described in table 117.

Table 117. Restricted other habitat treatment criteria

Stand Averages	
BA	70–90 ft²
Stand density index – % of max	25–40
18 inch + trees/acre (TPA)	≥20
Oak BA (square feet)	≥20+
Percent Total SDI by Size Class	
12–18”	≥15
18–24”	≥15
24+”	≥15

Manage for a range of density and structural characteristics by thinning areas with a southerly aspect to an overall average of 60 to 80 square feet of BA and areas with northerly aspect to an overall average of 80 to 100 square feet of BA. Density would vary within these ranges depending on existing stand structure.

Individual trees and tree groups would occupy approximately 60 to 75 percent of the area.

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

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

No trees larger than 24-inch d.b.h. would be cut.

Tree groups, on average, would range in size from 0.1 to 1 acre with northerly aspects and highly productive microsites having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

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

Trees within the dominate and codominant crown position would have priority for retention within groups. Where age class diversity is not present, 1 to 10 suppressed and intermediate trees per group would be retained for vertical diversity.

Interspace would occupy approximately 25 to 40 percent of the area.

Interspace width between tree groups would average from 25 to 60 feet with a maximum width of 200 feet.

Regeneration openings (group selection) account for 10 to 20 percent of tree groups. The percentage would vary within this range depending on current age class distribution. They would average 0.3 to 0.8 acre and would not exceed 200 feet wide. In general, regeneration openings would not be larger than 2 acres. However, they may extend up to 4 acres in specific areas where ponderosa pine mistletoe infections are heavy. They would only be established by removing groups of trees comprised of the most abundant tree size classes. Regeneration openings would be created adjacent to tree groups and would not be surrounded by interspace.

Manage moderate to heavy dwarf mistletoe infection centers that are not intended for regeneration openings for improved tree vigor and growth by retaining the best growing dominant and codominant trees with the least amount of mistletoe.

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

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

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches and at least 30 feet in height, CWD would be managed for 5 to 7 tons per acre; downed logs would be managed for three per acre ≥12 inches and a minimum of 8 feet in length.

Prescribed burns may be used to treat fuels and mitigate fuel hazards where and when feasible by increasing tree canopy base height, reducing litter/duff cover, and producing effects that stimulate regeneration and growth of native herbaceous vegetation. Prescribed fires are designed to maintain and enhance desired MSO restricted other habitat forest structure, tree densities, snag densities, and CWD levels.

Restricted Other Burn Only Treatment Design

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

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

Prescribed fires are designed to maintain and enhance desired MSO restricted other forest structure, tree densities, snag densities, and CWD levels.

Goshawk Habitat

General – Ponderosa Pine

Vegetation Management Direction: Manage for uneven-age stand conditions for live trees and retain live reserve trees, snags, downed logs, and woody debris levels throughout ponderosa pine forest cover types. Manage for old age trees such that as much old forest structure as possible is sustained over time across the landscape. Provide for or preserve existing clumps of trees with interlocking crowns. Sustain a mosaic of vegetation densities (overstory and understory), age classes, and species composition across the landscape. Encourage aspen and oak regeneration. Provide habitat for goshawk prey.

Desired Conditions: Highly interspersed, heterogeneous pattern and size of tree groups and interspace across the landscape. Tree groups are dominated by trees of a similar age and range from young to old (uneven aged). Interspace has a robust herbaceous layer.

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

Vegetation Management Direction: Distribution of vegetation structural stages for ponderosa pine – 10 percent grass/forb/shrub (VSS 1), 10 percent seedling-sapling (VSS 2), 20 percent young forest (VSS 3), 20 percent mid-aged forest (VSS 4), 20 percent mature forest (VSS 5), 20

percent old forest (VSS6). The distribution of VSS, tree density, and tree age are a product of site quality in the EMA. Use site quality to guide in the distribution of VSS, tree density, and tree ages. Snags are ≥18-inch d.b.h. and ≥30 feet in height, downed logs are 12 inches in diameter and are ≥8 feet long, woody debris is ≥3 inches on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape. Canopy cover guidelines apply only to mid-aged to old forest structural stages (VSS 4, VSS 5, and VSS 6). Further 4FRI direction is documented in the forest plan amendment that clarifies openness and clarifies that guidelines for canopy cover apply to mid-aged to old forest structural stage dominated tree groups across the LOPFA.

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

LOPFA, WUI55, UEA40, UEA25 and UEA10
Mechanical Thin and Burn Treatments Design

Uneven-age thinning and group selection would be used to establish interspace between individual trees and tree groups, thin tree groups, and create regeneration openings within LOPFA sites with none to low dwarf mistletoe infections that are uneven age or even age with a quadratic mean diameter (QMD) ≥ 8.5 inches.

Treatments would strive to attain an overall average density of 50 to 70 square feet of BA and 15 to 35 percent of maximum SDI inclusive of groups, interspaces, and regeneration openings. Density would vary within this range depending on treatment intensity and existing stand structure. See section D for more detail on the relationship of overall density to interspace, tree groups, and regeneration openings.

Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as displayed in table 118.

Table 118. Percent of trees, tree groups, and interspaces by treatment intensity (LOPFA)

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

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

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

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

Tree groups, on average, would range in size from 0.1 to 1 acre with lower treatment intensities having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

Tree group density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for tree groups for the WUI55, UEA40, UEA25, and UEA10 mechanical thin treatments are as described in table 119.

Table 119. LOPFA WUI and UEA treatments stocking guidelines for tree groups

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

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2] Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class; the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Manage mid-aged, mature and old (VSS 4, 5, and 6) tree groups for a range of density and structural characteristics by thinning approximately 50 percent of the mid-aged, mature, and old tree groups to the lower density stocking, approximately 20 percent each to the middle density and upper density of desired stocking conditions as displayed in the stocking guideline table, and approximately 10 percent remain unthinned.

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

Trees within the dominate and codominant crown position would have priority for retention within groups. Where age class diversity is not present, 1 to 10 suppressed and intermediate trees per group would be retained for vertical diversity.

Interspace width between tree groups would average from 25 to 120 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as described in table 120.

Table 120. Interspace percent and width in LOPFA WUI and UEA treatments

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

Regeneration openings (group selection) account for 10 to 20 percent of tree groups. The percentage would vary within this range depending on current VSS distribution. They would average 0.3 to 0.8 acre and would be no larger than 4 acres or 200 feet wide. They would only be established by removing groups of trees comprised of the most abundant tree size classes. Regeneration openings would be created adjacent to tree groups and would not be surrounded by interspace.

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

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

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

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

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

Prescribed fires are designed to maintain and enhance desired LOPFA UEA forest structure, tree densities, snag densities, and CWD levels.

LOPFA UEA – ADGF Design Mechanical Thin and Burn (Alternative C) Design

Same as LOPFA UEA 10 with the exception of group size. Tree group size is dependent on experimental design and would range in size from 1 to 15 acres.

LOPFA Intermediate Thin (IT) 40, 25, and 10
Mechanical Thin and Burn Treatments Design

Intermediate thinning (IT) would be used to establish interspace between individual trees and tree groups and thin tree groups within LOPFA sites with moderate to high dwarf mistletoe infection that are uneven age or even age with a QMD ≥ 8.5 inches.

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

Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as described in table 121.

Table 121. Percent of area occupied by trees, tree groups, and interspace in LOPFA IT

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

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

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

Tree groups, on average, would range in size from 0.1 to 1 acre with lower treatment intensities having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

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

Tree group density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS4), mature forest (VSS5), and old forest (VSS6) tree groups. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for VSS 4, 5, and 6 tree groups for the IT40, IT25, and IT10 mechanical thin treatments as described in table 122.

Table 122. Stocking guidelines for VSS 4 to 6 tree groups in LOPFA IT treatments

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

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2]Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Interspace width between tree groups would average from 25 to 80 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as described in table 123.

Table 123. Percent and width of interspace in LOPFA IT treatments

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

Manage for the sustainability of large oaks by removing ladder fuels and overtopping trees. Remove ponderosa pine that are within 30 feet of the base of oak 10-inch d.r.c. or larger as follows: (1) On the southerly side of the oak (135 to 315 degrees) trees up to 18-inch d.b.h. and (2) On the northerly side of the oak (316 to 134 degrees) trees in the intermediate or suppressed

crown positions up to 18-inch d.b.h. Exceptions to removal would be trees that meet the old tree definition and trees that have interlocking crown with oaks.

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

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

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

Prescribed fires are designed to maintain and enhance desired LOPFA IT forest structure, tree densities, snag densities, and CWD levels.

LOPFA Stand Improvement (SI) 40, 25, and 10
Mechanical Thin and Burn Treatments Design

Stand improvement thinning would be used to establish interspace between individual trees and tree groups, and thin tree groups within LOPFA sites with none to low dwarf mistletoe infection and are even-age sites with a QMD ≤ 8.5 inches.

Treatments would strive to attain an overall stand average density of 20 to 25 percent of maximum SDI inclusive of groups and interspaces. Density would vary within this range depending on treatment intensity and existing stand structure. See section D for more detail on the relationship of overall density to interspace and tree groups.

Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as described in table 124.

Table 124. Percent of area occupied by individual trees, tree groups, and interspace in LOPFA SI treatments

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

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

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

Tree groups, on average, would range in size from 0.1 to 1 acre with lower treatment intensities having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

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

Tree group density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for tree groups for the SI40, SI25, and SI10 mechanical thin treatments are as described in table 125.

Table 125. Stocking guidelines for tree groups in LOPFA SI treatments

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

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2]Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Interspace width between tree groups would average from 25 to 80 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as described in table 126.

Table 126. Interspace percent and width LOPFA SI treatments

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

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

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

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

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

Prescribed fires are designed to maintain and enhance desired LOPFA SI forest structure, tree densities, snag densities, and CWD levels.

LOPFA Pine Sage Mechanical and Burn Treatment Design

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

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

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

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

Replacement tree density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. See table 127 for the stocking guidelines for VSS 4, 5, and 6 tree groups for the pine-sage mechanical thin treatments.

Table 127. Stocking guidelines for VSS 4 to VSS 6 tree groups in LOPFA pine-sage treatments

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

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4, 5, and 6 classes are equivalent to 40 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2]Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

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

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

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

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

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

Prescribed fires are designed to maintain and enhance desired understory composition and cover as well as LOPFA pine sage forest structure, tree densities, snag densities, and CWD levels.

Savanna/Grassland Restoration
Mechanical and Burn Treatments Design

Restore pre-settlement tree density and pattern using pre-settlement evidence as guidance. Manage for an open reference condition with 10 to 30 percent of the area under ponderosa pine and deciduous tree crowns.

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

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

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

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

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

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

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

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

Prescribed fires are designed to maintain and enhance desired LOPFA savanna/grassland forest structure, tree densities, snag densities, and CWD levels.

LOPFA Burn Only Treatment Design

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

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

Prescribed fires are designed to maintain and enhance desired LOPFA forest structure, tree densities, snag densities, and CWD levels.

Goshawk PFA – Ponderosa Pine

Vegetation Management Direction: Provide for a healthy, sustainable forest environment for the post-fledgling family needs. The principle difference between "within the post-fledgling family area" and "outside the post-fledgling family area" is the higher canopy cover and smaller opening size within the post-fledgling family area. Vegetative structural stage distribution and structural conditions are the same within and outside the post-fledgling family area. Ponderosa pine canopy cover for mid-aged forest (VSS 4) should average one-third 60 plus percent and two-thirds 50 plus percent. Mature (VSS 5) and old forest (VSS 6) should average 50 plus percent. Further 4FRI direction clarifies that canopy cover guidelines apply to mid-aged to old forest structural stage dominated tree groups.

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

dPFA/PFA UEA40, dPFA/PFA UEA25 and
dPFA/PFA UEA10 Mechanical Thin and Burn Treatments Design

Uneven-age thinning and group selection would be used to establish interspace between individual trees and tree groups, thin tree groups, and create regeneration openings within dPFA/PFA sites with none to low dwarf mistletoe infections that are uneven age or even age with a QMD $\geq$ 8.5 inches.

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

Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as described in table 128.

Table 128. Percent of area occupied by individual trees, tree groups, and interspace in dPFA/PFA UEA treatments

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

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

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

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

Tree groups, on average, would range in size from 0.1 to 1 acre with lower treatment intensities having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

Tree group density would be managed to meet the canopy cover requirement of 50 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for tree groups for the dPFA/PFA UEA40, UEA25, and UEA10 mechanical thin treatments are described in table 129.

Manage mid-aged, mature, and old (VSS 4, 5, and 6) tree groups for a range of density and structural characteristics by thinning approximately 50 percent of the mid-aged, mature, and old tree groups to the lower density stocking, approximately 20 percent each to the middle density and upper density stocking as displayed in the stocking guideline table, and approximately 10 percent remain unthinned.

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

Table 129. Stocking guidelines for tree groups in dPFA/PFA WUI and UEA treatments

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

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4 classes are equivalent to 55 percent canopy cover; Densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2]Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Trees within the dominate and codominant crown position would have priority for retention within groups. Where age class diversity is not present, 1 to 10 suppressed and intermediate trees per group would be retained for vertical diversity.

Interspace width between tree groups would average from 25 to 70 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as described in table 130.

Table 130. Interspace percent and width in dPFA/PFA WUI and UEA treatments

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

Regeneration openings (group selection) account for 10 to 20 percent of tree groups. They would average 0.3 to 0.8 acre and would be no larger than 2 acres or 200 feet wide. They would only be established by removing groups of trees comprised of the most abundant tree size classes. Regeneration openings would be created adjacent to tree groups and would not be surrounded by interspace.

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

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

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

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

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

Prescribed fires are designed to maintain and enhance desired dPFA/PFA UEA forest structure, tree densities, snag densities, and CWD levels.

dPFA/PFA UEA – ADGF Design Mechanical Thin and Burn (Alternative C) Design

Same as dPFA/PFA UEA 10 with the exception of group size. Tree group size is dependent on experimental design and would range in size from 1 to 15 acres.

dPFA/PFA IT40, 25 and 10
Mechanical Thin and Burn Treatments Design

Intermediate thinning would be used to establish interspace between individual trees and tree groups and thin tree groups within dPFA/PFA sites with moderate to high dwarf mistletoe infection that are uneven age or even age with a QMD ≥ 8.5 inches.

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

Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as described in table 131.

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

Table 131. Percent of area occupied by trees and interspace for dPFA/PFA IT

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

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

Tree groups, on average, would range in size from 0.1 to 1 acre with lower treatment intensities having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

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

Tree group density would be managed to meet the canopy cover requirement of 50 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for VSS 4, 5, and 6 tree groups for the dPFA/PFA IT40, IT25, and IT10 mechanical thin treatments are described in table 132.

Table 132. dPFA/PFA IT treatments stocking guidelines for VSS 4 – 6 tree groups

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

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4 classes are equivalent to 55 percent canopy cover; Densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2]Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Interspace width between tree groups would average from 25 to 80 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as described in table 133.

Table 133. Interspace percent and width in dPFA/PFA IT

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

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

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

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

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

Prescribed fires are designed to maintain and enhance desired dPFA/PFA IT forest structure, tree densities, snag densities, and CWD levels.

dPFA/PFA SI40, 25, and 10 Mechanical Thin and Burn Treatments Design

Stand improvement thinning would be used to establish interspace between individual trees and tree groups and thin tree groups within dPFA/PFA even-age sites with a QMD ≤ 8.5 inches and with none to low dwarf mistletoe infection.

Treatments would strive to attain a stand average density of 20 to 25 percent of maximum SDI inclusive of groups and interspaces. These ranges would vary depending on treatment intensity and existing stand structure. See section D for more detail on the relationship of overall density to interspace and tree groups.

Individual trees, tree groups, and interspaces would occupy the following percent of the area by treatment intensity as described in table 134.

Table 134. Percent of area occupied by individual trees, tree groups, and interspaces in dPFA/PFA SI treatments

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

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

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

Tree groups, on average, would range in size from 0.1 to 1 acre with lower treatment intensities having larger average group sizes. Overall, average group size would vary within this range depending on site quality, existing stand structure, and pre-settlement tree evidence.

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

Tree group density would be managed to meet the canopy cover requirement of 50 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for tree groups for the dPFA/PFA SI40, SI25, and SI10 mechanical thin treatments are described in table 135.

Table 135. Stocking guidelines for tree groups in dPFA/PFA SI treatments

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

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4 classes are equivalent to 55 percent canopy cover; densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2] Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

Interspace width between tree groups would average from 25 to 80 feet with a maximum width of 200 feet. Average interspace width would vary depending on treatment intensity as described in table 136.

Table 136. Interspace percent and width in dPFA/PFA SI treatments

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

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

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

Gambel oak, juniper, and pinyon species greater than 5-inch drc may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

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

Prescribed fires are designed to maintain and enhance desired dPFA/PFA SI forest structure, tree densities, snag densities, and CWD levels.

dPFA/PFA Pine Sage Mechanical and Burn Treatment Design

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

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

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

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

Replacement tree density would be managed to meet the canopy cover requirement of 50 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups. By following the stocking guidelines and maintaining interlocking or nearly interlocking tree crowns, tree group density would meet and exceed the canopy cover requirements. Stocking guidelines for VSS 4, 5, and 6 tree groups for the pine sage mechanical thin treatments are as described in table 137.

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

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

Table 137. Stocking guidelines for VSS 4–6 tree groups in dPFA/PFA pine-sage treatments

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

[1] These are typical values for the mid-point diameter of the VSS class. Densities within the VSS 4 classes are equivalent to 55 percent canopy cover; densities within the VSS 5 and VSS 6 classes are equivalent to 50 percent canopy cover. Densities within the VSS 1, 2, and 3 classes are to maintain tree stocking necessary to provide for desired canopy cover as the groups mature to VSS 4, 5, and 6.

[2]Variation in tree group stocking above the minimum required to maintain canopy cover can occur and is desired. The smallest TPA number for the range pertains to the largest diameter of the VSS class, the highest TPA number for the range pertains to the smallest diameter of the VSS class. See section D for further detail on stocking by diameter.

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

Gambel oak, juniper, and pinyon species greater than 5-inch d.r.c. may be considered as residual trees in the target group spacing and stocking.

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

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

dPFA/PFA Burn Only Treatment Design

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

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

Prescribed fires are designed to maintain and enhance desired dPFA/PFA forest structure, tree densities, snag densities, and CWD levels.

Nest Area

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

the developmental history of the stand. Table 138 represents GTR-RM-217 attributes required for goshawks on location with "low" and "high" site productivity. The nesting area contains only mature to old forest (VSS 5 and 6) having a canopy cover (measured vertically) between 50 to 70 percent with old forest VSS 6 trees 200 to 300 years old. Nonuniform spacing of tree and clumpiness is desirable.

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

Goshawk Nest Area Burn Only Treatment Design

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

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

Prescribed fires are designed to maintain and enhance desired dPFA/PFA forest structure, tree densities, snag densities, and CWD levels. Desired goshawk nest stand structural attributes are as described in table 138.

Table 138. Minimum structural attributes in suitable goshawk nest stands*

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

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

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

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

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

Pinyon Juniper (PJ) WUI Mechanical Thin and Burn Treatment Design

Uneven-age thinning would be used to establish interspace between tree groups and thin tree groups within LOPFA PJ sites.

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

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

Between groups, thin from below to 16-inch d.r.c. for pinyon and juniper and 16-inch d.b.h. for ponderosa pine (see next).

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

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

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

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

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

Prescribed fires are designed to maintain and enhance desired LOPFA PJ WUI forest structure, tree densities, snag densities, and CWD levels.

Other Areas Outside MSO and Goshawk Habitats

Aspen

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

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

Aspen Mechanical Thin and Burn Treatment Design

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

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

Snags would be managed for two per acre ≥18 inches, CWD would be managed for 5 to 7 tons per acre, and downed logs would be managed for three per acre ≥12 inches.

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

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

Aspen Burn Only Treatment Design

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

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

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

Grassland

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

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

Grassland Mechanical Thin and Burn Treatment Design (Alternative C Only)

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

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

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

Gambel oak would be retained.

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

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

Section B – Decision Matrix

Table 139. Section B decision matrix for establishing tree groups, interspace, and regeneration openings

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

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

Section C – Old Tree Implementation Plan

Old Tree Descriptions and Illustrations

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

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

Old trees would be determined by the following characteristics described by Thomson (1940) as age class 3 (intermediate-mature) and age class 4 (mature-overmature).

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

Figure 72 and figure 73 display illustrations of age class 3 (intermediate-mature) and age class 4 (mature-overmature) from Thompson 1940.

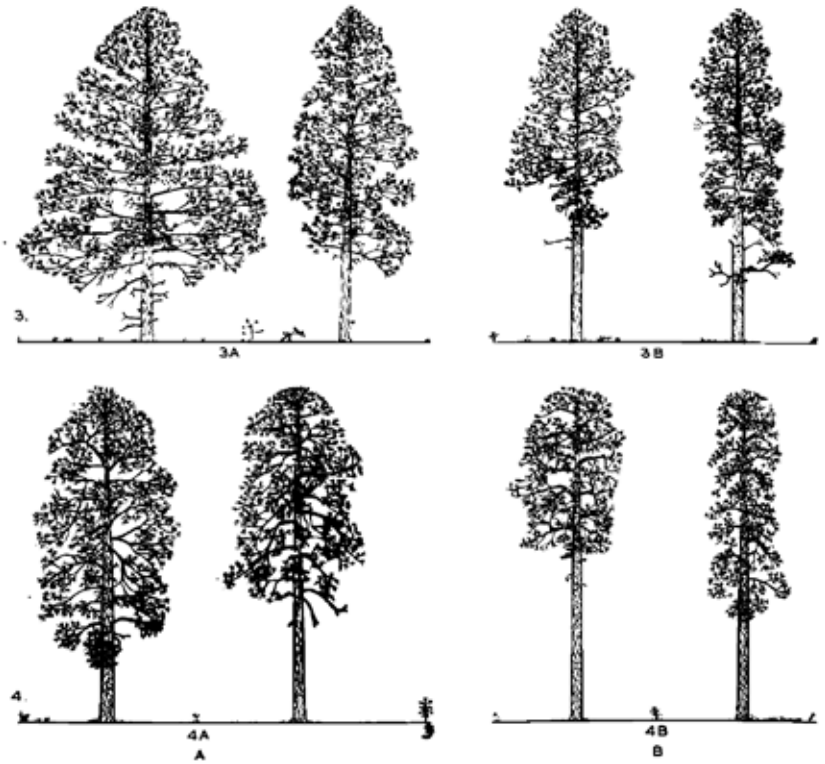

Figure 72. Old tree characteristics (Thompson 1940)

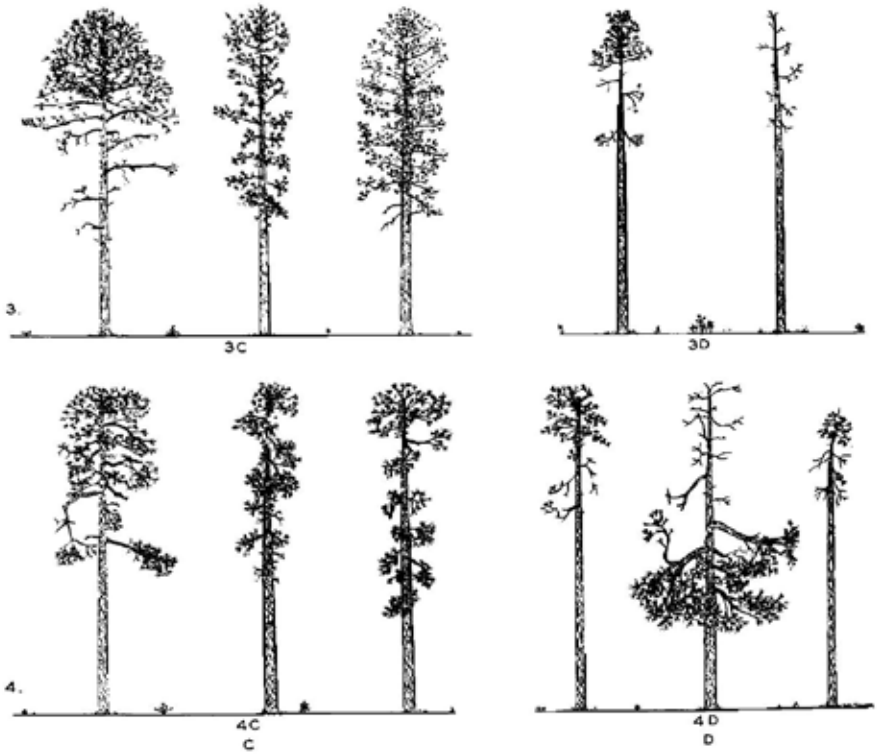

Figure 73. Old age tree characteristics continued (Thompson 1940)

Section D – Modified Large Tree Implementation Plan (Alternative C)

Introduction

The large tree implementation plan is specific to alternative C. It is designed to inform implementation. It responds to comments received during scoping (August 2011). The plan's desired conditions are consistent with the summarized desired conditions found in the project's purpose and need and the plan provides additional citations that support the desired conditions. It incorporates the old tree implementation plan be reference.

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

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

Seeps and Springs

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

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

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

Desired Conditions

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

Riparian

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

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

Desired Conditions

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

Wet Meadows

High elevation streamside or spring-fed meadows occur in numerous locations throughout the Southwest. However, less than 1 percent of the landscape in the region is characterized as wetland

(Dahl 1990), and wet meadows are just one of several wetland types that occur. Patton and Judd (1970) reported that approximately 17,700 hectares of wet meadows occur on national forests in Arizona and New Mexico.

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

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

Desired Conditions

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

Encroached Grasslands

Encroached grasslands are herbaceous ecosystems that have infrequent to no evidence of pine trees growing prior to settlement. The two prevalent grassland categories in the 4FRI landscape are montane (includes subalpine) grasslands and Colorado Plateau (a subset of Great Basin)

grasslands, with montane grasslands being most common (Finch 2004). A key indicator of grasslands is the presence of mollisol soils. Mollisol soils are typically deeper with higher rates of accumulation and decomposition of soil organic matter relative to soils in the surrounding landscape. Grasslands in this region evolved during the Miocene and Pliocene periods, and the dark, rich soils observed in grasslands today have taken more than 3 million years to produce. In addition to their association with mollic soils, grasslands in this region are maintained by a combination of climate, fire, wind desiccation and, to a lesser extent, by animal herbivory (Finch 2004).

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

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

Desired Conditions

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

Aspen Forest and Woodland

Quaking aspen (*Populus tremuloides*) occurs in small patches throughout the 4FRI project area. Bartos (2001) refers to three broad categories of aspen: (1) stable and regenerating (stable), (2) converting to conifers (seral), and (3) decadent and deteriorating. Almost all of the aspen occurring within ponderosa pine forests of the 4FRI project area is seral aspen, which regenerates after disturbance through root sprouting and rarely from seed production (Quinn and Wu 2001).

Favorable soil and moisture conditions maintain stable aspen over time. Aspen stands have been mapped across the entire 4FRI area and map layers are available from existing databases.

Aspen occurs within ponderosa pine forests. It is ecologically important due to the high concentration of biodiversity that depends on aspen for habitat (Tew 1970, DeByle 1985, Finch and Reynolds 1987, Griffis-Kyle and Beier 2003). In addition, stable aspen stands serve as an indicator of ecological integrity (Di Orio et al. 2005). Aspen is currently declining at an alarming rate (Fairweather et al. 2008).

The lack of fire as a natural disturbance regime in southwestern ponderosa pine forests since European settlement has caused much of the aspen dominated lands to cede to conifers (Bartos 2001). Other factors contributing to gradual aspen decline over the past 140 years include reduced regeneration from browsing ungulates (Pearson 1914, Larson 1959, Martin 1965, Jones 1975, Shepperd and Fairweather 1994, Martin 2007). More recently, aerial and ground surveys indicate more rapid decline of aspen, with very high mortality occurring in low and mid-elevation aspen sites. Major factors thought to be causing this rapid decline of aspen include frost events, severe drought, and a host of insects and pathogens (Fairweather et al. 2008) that have served as the "final straws" for already compromised stands.

Desired Conditions

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

Ponderosa Pine/Gambel Oak Forest (Pine-Oak)

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

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

Gambel oak provides high quality wildlife habitat in its various growth forms and is a desirable component of ponderosa pine forests (Neff et al. 1979, Kruse 1992, Bernardos et al. 2004). Gambel oak enhances soils (Klemmedson 1987), wildlife habitat (Kruse 1992, Rosenstock 1998, USDI 1995, Bernardos et al. 2004), and understory community composition (Abella and Springer 2008). Large oak trees are particularly valuable since they typically provide more natural cavities and pockets of decay that allow excavation and use by cavity nesters than conifers. In addition to its important ecological role, Gambel oak has high value to humans as it is a popular firewood that possesses superior heat-producing qualities compared to other tree species (Wagstaff 1984).

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

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

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

Desired Conditions

All Gambel Oak

- Small oak trees develop into larger size classes.
- Fire treatments retain small and shrubby oak in numbers and distribution.
- All growth forms of Gambel oak are present and larger, older oak trees are enhanced and maintained.
- Large, post-settlement trees are not restricting oak development.
- Frequent, low intensity surface fire occurs in ponderosa pine-Gambel oak forests.
- Brushy thicket, pole, and dispersed clump growth forms of Gambel oak are present and maintained by allowing natural self-thinning, thinning dense clumps, and/or burning.
- Gambel oak growth forms are protected from damage during restoration treatments including thinning and post-thinning slash burning.

In MSO Restricted Habitat

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

Outside MSO Restricted Habitat

- Large post-settlement trees' drip lines or roots do not overlap with those of Gambel oak trees exhibiting >8 inch d.r.c.

Within-stand Openings

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

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

Within-stand openings appear to have been self-perpetuating before overgrazing and fire exclusion (Pearson 1942, Sánchez Meador et al. 2009). Fully occupied by the roots of grasses and wildflowers as well as those of neighboring groups of trees, these openings had low water and nutrient availability because of intense root competition (Kaye et al. 1999). Heavy surface fuel loads insured that tree seedlings were killed by frequent surface fires, reinforcing the competitive exclusion of tree seedlings (Fulé et al. 1997).

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

Desired Conditions

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

- Openings promote snowpack accumulation and retention which benefits groundwater recharge and watershed processes at the fine (1 to 10 acres) scale.
- The presence of such trees does not prevent the reestablishment of sufficient within-stand openings to emulate natural vegetation patterns based on current stand conditions, pre-settlement evidences, desired future conditions, or other restoration objectives.
- Groups of trees typically range in size from 0.1 acre to 1 acre. Canopy gaps and interspaces between tree groups or individuals are based on site productivity and soil type and range from 10 percent on highly productive sites to as high as 90 percent on those soil types that have an open reference condition.
- Suitable openings for successful natural regeneration in this project would range in size from 3/10 to 8/10 of an acre.

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

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

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

Desired Conditions

- Natural heterogeneity of forest, savanna, and grasslands occurs at the landscape scale and within stands.
- Groups are restored by retaining the largest trees on the landscape to reestablish old growth structure in the shortest timeframe possible.
- Decreased shading and interception from the canopy, decreased needle litter and duff, and surface fire restore and maintain a mosaic of natural vegetative communities.
- Decreased shading and interception from the canopy fuels allow the growth of continuous herbaceous surface fuels to carry surface fire.
- Reduced horizontal and vertical canopy fuels reduce the potential for crown fire.
- Fire is the principle regulator of forest structure over time.

- Regeneration openings that contribute to the ecological objective of natural heterogeneity of historical forest structure and age class diversity are not encroached upon by trees.

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

Table 140. Section E the relationship between treatment intensity, tree group density, and overall average density

Treatment Intensity	Percent of Area		Percent of Treed Area		Avg. Group BA to Achieve Overall BA of:					
	Interspace	Tree	Groups and Individuals	Regeneration	40	50	60	70	80	90
10–25	**10**	**90**	90	0		56	67	78	89	100
			85	5		59	71	82	94	
			80	10		63	75	88	100	
			75	15		67	80	93	107	
			70	20		71	86	100	114	
	15	**85**	85	0		59	71	82	94	106
			80	5		63	75	88	100	
			75	10		67	80	93	107	
			70	15		71	86	100	114	
			65	20		77	92	108	123	
	20	**80**	80	0		63	75	88	100	113
			75	5		67	80	93	107	
			70	10		71	86	100	114	
			65	15		77	92	108	123	
			60	20		83	100	117	133	
25–40	**25**	**75**	75	0		67	80	93	107	120
			70	5		71	86	100	114	
			65	10		77	92	108	123	
			60	15		83	100	117	133	
			55	20		91	109	127	145	
	30	**70**	70	0		71	86	100	114	129
			65	5		77	92	108	123	
			60	10		83	100	117	133	
			55	15		91	109	127	145	

Treatment Intensity	Percent of Area		Percent of Treed Area		Avg. Group BA to Achieve Overall BA of:					
	Interspace	Tree	Groups and Individuals	Regeneration	40	50	60	70	80	90
			50	20		100	120	140	160	
	35	**65**	65	0		77	92	108	123	138
			60	5		83	100	117	133	
			55	10		91	109	127	145	
			50	15		100	120	140	160	
			45	20		111	133	156	178	
40–55	**40**	**60**	60	0	67	83	100	117	133	150
			55	5	73	91	109	127	145	
			50	10	80	100	120	140	160	
			45	15	89	111	133	156	178	
			40	20	100	125	150	175	200	
	45	**55**	55	0	73	91	109	127	145	164
			50	5	80	100	120	140	160	
			45	10	89	111	133	156	178	
			40	15	100	125	150	175	200	
			35	20	114	143	171	200	229	
	50	**50**	50	0	80	100	120	140	160	180
			45	5	89	111	133	156	178	
			40	10	100	125	150	175	200	
			35	15	114	143	171	200	229	
			30	20	133	167	200	233	267	
55–70	**55**	**45**	45	0	89	111	133	156		
			40	5	100	125	150	175		
			35	10	114	143	171	200		
			30	15	133	167	200	233		
			25	20	160	200	240	280		
	60	**40**	40	0	100	125	150	175		
			35	5	114	143	171	200		
			30	10	133	167	200	233		
			25	15	160	200	240	280		
			20	20	200	250	300	350		

Treatment Intensity	Percent of Area		Percent of Treed Area		Avg. Group BA to Achieve Overall BA of:					
	Interspace	Tree	Groups and Individuals	Regeneration	40	50	60	70	80	90
	65	**35**	35	0	114	143	171	200		
			30	5	133	167	200	233		
			25	10	160	200	240	280		
			20	15	200	250	300	350		
			15	20	267	333	400	467		

Note: Red fill indicates red SDI zone for all diameters. Red zone group BA ranges from 125 BA for 8-inch QMD to 195 BA for 24-inch QMD.
* Average Group Basal Area (BA) to achieve overall BA.

TPA by QMD and BA:

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

Color coding key:

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

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

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

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

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

Figure 74. Section E density management and stocking guidelines