

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD AND SPECIFICATIONS**

**FOREST STAND IMPROVEMENT**

(Acre)  
CODE 666

**DEFINITION**

The manipulation of species composition, stand structure and stocking by cutting or killing selected trees and understory vegetation.

**PURPOSE**

- Increase the quantity and quality of forest products by manipulating stand density and structure.
- Harvest forest products.
- Initiate forest stand regeneration.
- Reduce wildfire hazard.
- Improve forest health reducing the potential of damage from pests and moisture stress.
- Restore natural plant communities.
- Achieve or maintain a desired native understory plant community for special forest products, grazing, and browsing.
- Improve aesthetic and recreation, values.
- Improve wildlife habitat.
- Alter water yield.
- Increase carbon storage in selected trees.
- Provide renewable energy production.

**CONDITION WHERE PRACTICE APPLIES**

All forest land.

**CRITERIA**

**General Criteria Applicable to All Purposes**

Stocking recommendations shall be expressed in terms of canopy cover, basal area, spacing or trees per acre by species and size class.

The harvest-regeneration strategy will be identified for all planned forest improvement harvesting using one of the following:

- Uneven-aged management systems (e.g., single-tree selection, group selection, coppice selection)
- Even-aged management (e.g., clear-cut, seed-tree, shelterwood, coppice)

Spacing, density, size class, number and amounts of trees and understory species to be retained will follow established guidelines for the intended purposes. See Conservation Practice Information Sheet- Crop Tree Management (IS-MO666cut) for further guidance.

Soil erosion, displacement, hydrologic impact and damage to remaining vegetation will not exceed acceptable levels. Minimize disturbances such as rutting, soil compaction, excessive disturbance to the litter layer, and the addition of fill material.

Limit damage to the site by:

- using directional felling
- aligning cut tree stems for efficient skidding
- cutting out forks and large branches
- limiting trails to less than 15% of the site
- logging when the soil is dry or frozen
- using smallest size equipment possible
- using well-organized access trails

The method, felling direction, and timing of tree cutting shall facilitate efficient and safe tree removal and protect sensitive areas or species such as vernal pools, riparian zones, cultural resources, threatened and endangered species, and state species of concern.

Slash, debris and vegetative material left on the site after treatment will not present an unacceptable fire or pest hazard or interfere with the intended purpose. Refer to FOREST SLASH TREATMENT (384) and PRESCRIBED BURNING (338).

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service or download the standard from the [electronic Field Office Technical Guide](#) for Missouri.

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Kill unwanted trees, shrubs, and vines by any of the following means:

- cutting
- girdling
- frilling
- stem injection
- basal bark spray

*Herbicide application following mechanical cutting, girdling, and frilling will increase mortality and reduce stump sprouting*

When choosing herbicides, review leaching, runoff potential, setback requirements, persistence, and toxicity ratings of chemical formulations. Use the safest available herbicide. Pesticides used improperly can be injurious to man, animals, and plants. Follow all label directions and label precautions.

Base forest stand improvement choices on:

- relative tree position
- crown position
- crown condition
- tree health
- stem quality
- species
- land user objectives

Protect riparian zones, unique areas, and structures. Leave a strip of existing native woody vegetation, a minimum 50 feet wide, along any non-woodland border. This strip will provide wind protection for the remaining stand, provide food and cover for wildlife, improve visual aesthetics, and protect water quality. Light forest stand improvement work or edge-feathering (See JS-BIOL-18 Edge Feathering Job Sheet) can be done in this strip. Where riparian protection is needed, follow RIPARIAN FOREST BUFFER (391).

Release cuttings should generally be done before the stand is 15 years old or as soon as the need becomes apparent. Cut or deaden:

- cull and "wolf" trees (may be retained for wildlife)
- undesirable species
- damaged or diseased trees
- surplus sprouts

Prescribed fire may be used to:

- remove undesirable hardwoods;

- reduce fuel build-up;
- expose mineral soil for improved germination;
- adjust community structure and composition.

Refer to PRESCRIBED BURNING (338) for additional guidance. A prescribed burn plan shall be prepared.

Comply with applicable laws and regulations.

For forest, woodland, and savanna communities protect the area from domestic livestock grazing with exclusion. See ACCESS CONTROL (472) for further guidance.

For silvopasture systems, follow SILVOPASTURE ESTABLISHMENT (381) when domestic livestock grazing is involved.

**Additional Criteria to Increase the Quantity and Quality of Forest Products by Manipulating Stand Density and Structure**

All management decisions shall be based on a woodland inventory and the intended purpose.

Start thinning at an early age when the activity is expected to produce the desired effect on the targeted size class(es) and species. Additional thinning, based on site index, can occur at 10-15 year intervals, up until three-fourths of the rotation age is reached for even-aged stands. For uneven-aged stands additional forest stand improvements can occur at 10-20 year intervals, indefinitely.

Strip or row thinning is possible in plantations with straight rows. Remove one-third of the stand or every third row.

For even-aged stands with an average DBH of 6 inches or more, use the following table as a guide for residual stocking after thinning:

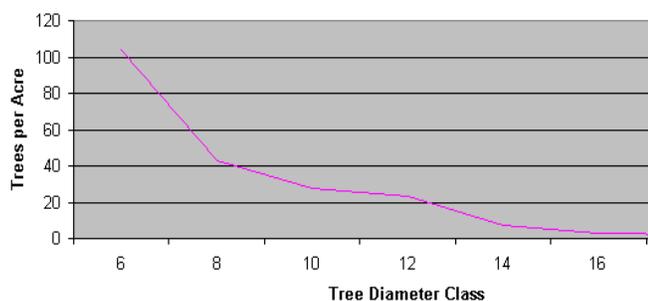
Stand Diameter (inches)	Spacing (feet)	Basal Area (sq. ft.)	Trees/Acre (no.)
<b>Hardwood</b>			
6	13	55	258
8	16	60	170
10	19	65	121
<b>Pine</b>			
6	12	60	304
8	14	75	222
10	16	90	170

Keep improvement cuttings light enough (maintain at least 60% stocking) to restrict the growth of any undesirable species, to maintain full site utilization, to reduce sunscald damage and to reduce epicormic branching (a shoot sprouting from a dormant bud on the stem of a tree) and basal sprouting.

For uneven-aged stands create or maintain age classes which occupy an equal amount of ground space per acre. Each improvement activity should:

- regenerate a new age/size class (if needed)
- harvest mature trees and excess numbers in each age class
- balance the diameter class distribution (see following chart)

Diameter Distribution of an Uneven-Aged Stand



Remove/kill among the age/size classes according to the following priority:

- defective and diseased trees
- high risk trees that might not survive another cutting cycle
- low value trees of any species
- least desirable species.
- excess numbers of desired species

With all thinning, provide at least 5 to 10 feet of crown growing space on a minimum of two sides of residual trees.

Thin stands below 6 inches DBH to a 10-foot spacing.

In pine stands, where root rot (*Fomes annosus*) may be a problem, restrict thinning to the summer months to minimize infection.

#### *Crop Tree Management:*

Select 20 to 75 crop trees per acre based on the following criteria:

- dominant or codominant canopy tree
- healthy crown
- minimal epicormic branching
- good form
- free of defects and disease
- desired species
- adapted species

Remove all trees in direct adjacent competition with the crop trees. Provide at least 10 to 15 feet of crown growing space on all sides of residual crop trees. See Conservation Practice Information Sheet- Crop Tree Management (IS-MO666ctm) for further guidance.

#### *Woody Biomass Harvesting:*

Follow guidelines outlined in Missouri Woody Biomass Harvesting, Best Management Practices Manual (MDC-F00005).

#### **Additional Criteria to Reduce Wildfire Hazard**

Reduce stocking rates of trees to minimize crown-to-crown spread of fire.

Remove "ladder" fuels to minimize the occurrence of crown fires.

Further treat or eliminate slash accumulations next to roads and trails.

Reduce or eliminate species with high volatility but not to a level that would compromise other intended purposes.

For additional wildfire risk and damage reduction, refer to FIRE BREAK (394).

#### **Additional Criteria to Improve Wildlife Habitat**

Manage for tree species and stocking rates that meet desired wildlife species food and cover requirements and community restoration needs.

*Woodland or forest thinning will encourage fuller crown development, earlier seed production, and heavier herbaceous plant development.*

Create, recruit and maintain sufficient snags and down woody material to meet requirements of desired species in balance with conditions needed to achieve other intended purposes.

Rotate forest stand improvements throughout the forest so that various stages of plant succession will be established.

*Wildlife as a Secondary Objective:*

Leave or establish 3 snags and 3 den trees per acre, ranging in size from 6 to 20 inches DBH.

Leave 2 to 3 vines per acre. Favor trees with vines that will be left as den trees or oak species greater than 10 inches DBH.

*Wildlife as a Primary Objective:*

Favor hard-mast producers (oak, hickory, pecan and walnut) and native conifers.

Leave or establish 6 snags and 6 den trees per acre, ranging in size from 6 to 20 inches DBH.

Leave 4 to 6 vines per acre. Favor trees with vines that will be left as den trees or oak species greater than 10 inches DBH.

Low intensity prescribed fires may be used to improve/increase green browse for wildlife. Refer to PRESCRIBED BURNING (338) for additional guidance. A prescribed burn plan shall be prepared.

Improve wildlife habitat in the stand by adding one or more of the following:

- Downed Tree Structure
- Permanent forest opening
- Temporary forest opening
- Edge feathering

*Caution should be exercised when proposing permanent openings in forest sites larger than 250 contiguous acres. Openings in this situation may lead to habitat fragmentation for non-target interior nesting species and increased predation.*

Refer to UPLAND WILDLIFE HABITAT MANAGEMENT (645) and WETLAND WILDLIFE HABITAT MANAGEMENT (644) to further develop and manage wildlife-related activities.

### **Additional Criteria to Improve Aesthetics and Recreation Values**

This activity is strongly influenced by subjective values and interests. Direct forest stand improvement toward:

- opening vistas
- installing trails
- increasing vegetation diversity (shape, texture, color, size)
- removing safety hazards near pedestrian use areas (snags, large dead limbs, etc.)
- creating visual screens

For additional guidelines refer to RECREATION AREA IMPROVEMENT (562) and RECREATION TRAIL AND WALKWAY (568).

### **Additional Criteria to Increase Carbon Storage**

All management decisions shall be based on a woodland inventory and the intended purpose.

Manage for tree species and stocking rates that have higher rates of growth and potential for carbon sequestration and are adapted to the site to assure strong health and vigor. See list below for recommended species:

Aspen, quaking, *Populus tremuloides*  
 Baldcypress, *Taxodium distichum*  
 Basswood, American, *Tilia americana*,  
 Boxelder, *Acer negundo*  
 Catalpa, northern, *Catalpa speciosa*  
 Cherry, black, *Prunus serotina*  
 Cottonwood, eastern, *Populus deltoides*  
 Cucumbertree, *Magnolia acuminata*  
 Hackberry, *Celtis occidentalis*  
 Honey locust, *Gleditsia triacanthos*  
 Kentucky coffeetree, *Gymnocladus dioica*  
 Locust, black, *Robinia pseudoacacia*  
 Maple, silver, *Acer saccharinum*  
 Mulberry, red, *Morus rubra*  
 Oak, black, *Quercus velutina*  
 Oak, northern red, *Quercus rubra*  
 Oak, pin, *Quercus palustris*  
 Oak, scarlet, *Quercus coccinea*  
 Pine, loblolly, *Pinus taeda*  
 Pine, red, *Pinus resinosa*  
 Pine, shortleaf, *Pinus echinata*  
 Pine, pitch-loblolly, *Pinus rigida x taeda*  
 Poplar, yellow, *Liriodendron tulipifera*  
 Spruce, Norway, *Picea abies*  
 Sugarberry, *Celtis laevigata*  
 Sweetgum, *Liquidambar styraciflua*  
 Sycamore, *Platanus occidentalis*  
 Walnut, black, *Juglans nigra*  
 Willow, black, *Salix nigra*

## CONSIDERATIONS

Silvicultural objectives and harvest-regeneration strategies may change over time and may be limited by prior management.

Clients should be advised of responsibilities of wildfire control and consider the development of a wildfire control plan including “defensible” space, access routes, fire-season water source, and location of wildfire control facilities.

Consult a professional forester for assistance in the planning and implementation of complex sites.

Forest stand improvement activity for lumber/veneer production is generally not justified on poor sites (below site index 55 if managing for oaks; or site index 45 if managing for shortleaf pine).

Forest stand improvement activity can impact water quality by causing a temporary increase in erosion rates and sediment yield.

The practice should be timed to minimize disturbance of seasonal wildlife activities.

Consider wildlife food and cover needs when making modifications to forest composition and tree spacing.

The extent, timing, size of treatment area, or the intensity of the practice should be adjusted to minimize cumulative effects (onsite and offsite), e.g., hydrologic and stream alteration, habitat fragmentation, nutrient cycling, biodiversity and visual resources.

When using trees and shrubs to offset greenhouse gas emissions through carbon sequestration, carbon sequestration prediction rates should be made using current, approved carbon sequestration modeling technology.

## PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes and narrative statements in the conservation plan, or other acceptable documentation.

## OPERATION AND MAINTENANCE

Periodic inspections during and after treatment activities are necessary to ensure that purposes are achieved and resource damage is minimized, e.g., assessment of insects, disease and other pests, storm damage, and damage by trespass. The results of inspections shall determine the need for additional treatment under this practice.

## REFERENCES

*Forestry Handbook, Second Edition; Society of American Foresters; 1984.*

*Managers Handbook for Oaks in the North Central States; General Technical Report NC-37; North Central Forest Experiment Station, Forest Service, USDA; 1977.*

*Managing Shortleaf Pine in Missouri; Station Bulletin 875; Agricultural Experiment Station, University of Missouri; 1969.*

*The Practice of Silviculture; David M. Smith; John Wiley & Sons, Eighth Edition; 1986.*

*Snag and Den Tree Management; Timber and Wildlife Benefits on Private Land-No.5; Missouri Conservation Commission; 1985.*

*Central Hardwood Notes. Jay Hutchinson, Editor. USDA Forest Service. North Central Forest Experiment Station; 1989.*

*Missouri Woody Biomass Harvesting, Best Management Practices Manual (MDC-F00005); 2009.*