

**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.
- Timely harvest of forest products
- Development of renewable energy systems.
- 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.

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 extent or size and orientation of treatment area(s) shall be identified as part of the practice design.

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 Forest Stand Improvement Job Sheet (JS-MO666) and 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.

For forest improvement harvest, limit damage to the site and residual stand 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

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Refer to Forest Trails and Landings (655). 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.

Protect riparian zones, unique areas, and structures. Maintain a fully stocked strip of existing native woody vegetation, a minimum 50 feet wide, adjacent to sensitive areas and along non-woodland borders. 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).

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 WOODY RESIDUE TREATMENT (384) and PRESCRIBED BURNING (338).

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

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

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- tree health
- stem quality
- species
- land user objectives

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 improve diversity;
- create or enhance wildlife habitat

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

Comply with applicable laws and regulations.

For forestland and woodland communities protect the area from domestic livestock grazing. See ACCESS CONTROL (472) for further guidance. Grazing by domestic livestock is only allowed as a component of a forest management plan, wildlife management plan, or livestock grazing plan for invasive and/or exotic species management or natural community management as approved by a professional forester or biologist.

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

Average Stand Diameter (inches)	Spacing (feet)	Basal Area (sq. ft.)	Trees/Acre (no.)
Hardwood			
6	13	55	258
8	16	60	170
10	19	65	121
12	23	70	82
Pine			
6	12	60	304
8	14	75	222
10	16	90	170
12	18	105	134

inches or more, use the following table as a guide for residual stocking after thinning:

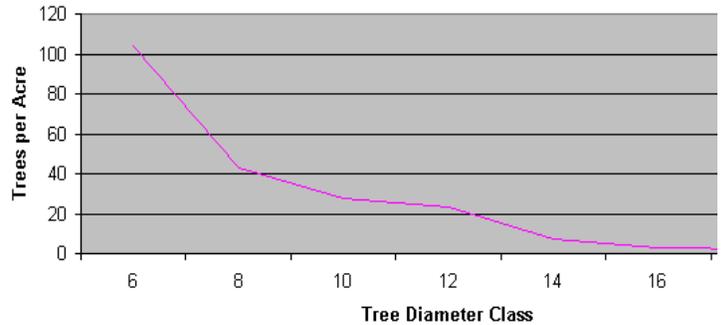
Keep improvement cuttings light enough (maintain at least 60% stocking) to restrict the growth of any undesirable species, to maintain full site utilization, to reduce sunscald damage and to reduce epicormic branching (a shoot sprouting from a dormant bud on the stem of a tree) and basal sprouting.

Utilize multiple entries spaced several years apart in heavily overstocked stands to avoid reducing the stocking level to a point where windthrow and excessive epicormic branching are likely to occur.

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, ensure that the tops of the residual trees are open to direct sunlight and provide at least 5 to 10 feet of growing space on a minimum of two sides of the trees' crowns.

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.

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Additional Criteria to Develop Renewable Energy Systems

Intensity and frequency of energy biomass removals will be managed to prevent long-term negative impacts on the stand.

The harvesting of energy biomass shall be accomplished in a manner that will not compromise the other intended purpose(s) and functions. 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 a variety of native tree species and stocking rates that meet desired wildlife species and pollinator 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, den trees, down woody material, and suitable vines to meet requirements of desired species in balance with conditions needed to achieve other intended purposes. For additional guidance refer to UPLAND WILDLIFE HABITAT MANAGEMENT (645).

Also refer to EARLY SUCCESSIONAL HABITAT DEVELOPMENT/MANAGEMENT (647), RESTORATION AND MANAGEMENT OF RARE AND DECLINING HABITATS (643), 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

Base all management decisions 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. Refer to Conservation Tree/Shrub Suitability Groups in Section II. of eFOTG to determine trees to manage.

CONSIDERATIONS

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

Successful regeneration of desirable species is usually dependent upon timely application of forest stand improvement and other practices, e.g., prescribed burning, site preparation, tree and shrub establishment, and access control.

Advise clients of their responsibilities for 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.

Advise landowners to secure a written contract with any service provider that specifically describes the extent of activity, duration of activity, liability and responsibilities of each party and amount and timing of payments for services provided.

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).

Slash, debris and other vegetation (biomass) removed during stand improvement may be used to produce energy. Management alternatives should consider the amount of energy required to produce and convert the biomass into energy with the amount produced by the biomass. Wildlife and sustainability guidelines should also be considered.

Invasive or noxious woody vegetation should be controlled. Refer to BRUSH MANAGEMENT (314).

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 and pollinator activities.

Consider wildlife food and cover needs when making modifications to forest composition and tree spacing. Thin to 60% stocking or less to encourage fuller crown development, increase seed production, and promote herbaceous plant development.

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.

Favor hard-mast producers (oak, hickory, pecan and walnut) and Shortleaf pine on suitable sites.

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.

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

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. Refer to JS-MO666.

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.

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REFERENCES

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

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.

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