Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

FOREST STAND IMPROVEMENT

CODE 666

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DEFINITION

The manipulation of species composition, stand structure, or stand density by cutting or killing selected trees or understory vegetation to achieve desired forest conditions or obtain ecosystem services.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve and sustain forest health and productivity
- Reduce damage from pests and moisture stress
- Initiate forest stand regeneration
- Reduce fire risk and hazard and facilitate prescribed burning
- Restore or maintain natural plant communities
- Improve wildlife and pollinator habitat
- Alter quantity, quality, and timing of water yield
- Increase or maintain carbon storage

CONDITIONS WHERE PRACTICE APPLIES

All land where the quantity and quality of trees can be enhanced.

CRITERIA

General Criteria Applicable to All Purposes

Describe the extent or size and orientation of treatment area(s). Separate forest land with different cover types, timber types, or other distinctive characteristics into separate management units (stands) and plan them individually.

Base all management decisions on landowner objectives, a woodland inventory, and the intended purpose.

Based on a woodland inventory, identify and retain preferred tree and understory species to achieve all planned purposes and landowner objectives.

Use available guidelines for species and species groups to determine spacing, density, size-class distribution, number of trees, and amount of understory species to be retained for the intended purpose. Schedule treatments to avoid overstocked conditions using approved silvicultural stocking guides.

Describe the current and desired future condition of each stand that will be treated. Include the species, cover type, and size-class distribution. Described stocking and levels of treatment in terms of crop trees per acre, basal area per acre, trees per acre, between-tree spacing, or by any other appropriate and

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professionally accepted density or stocking protocol. See approved Illinois Forest Management Plan (IFMP) and/or Forest Stand Improvement Job Sheet (JS-IL666) and Illinois Forestry Technical Note – Crop Tree Management (TN1-IL666CTM) for further guidance.

Use the safest available herbicide. When choosing herbicides, review flashback potential, leaching, runoff potential, setback requirements, persistence, and toxicity ratings of chemical formulations. Follow all label directions and label precautions.

Refer to WIN-PST criteria in NRCS Conservation Practice Standard (CPS) Code 595, Integrated Pest Management, and comply with applicable State and local laws if an herbicide will be used.

Time tree felling to avoid buildup of insect or disease populations.

Implement forest stand improvement activities in ways that avoid or minimize soil erosion, compaction, rutting, and damage to remaining vegetation, and that maintain hydrologic conditions. Protect site resources by selecting the method, felling direction and timing of tree felling, and heavy equipment operation. For temporary access use NRCS CPS Code 655, Forest Trails and Landings, to protect soil and site resources from vehicle and equipment impacts.

Use NRCS CPS Code 560, Access Road, for more heavily used roads associated with forest stand improvement activities.

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

- cut stump treatment
- girdling/frilling
- stem injection
- basal bark spray

See Illinois Forestry Technical Note – Controlling Undesirable Trees and Shrubs (TN2-IL666CUTS) for further guidance.

Where slash and debris will be generated, use NRCS CPS Code 384, Woody Residue Treatment, to appropriately treat slash and debris, as necessary, to assure that it will not present an unacceptable fire, safety, environmental, or pest hazard. Remaining woody material will be placed so that it does not interfere with the intended purpose or other management activities. Do not burn vegetative residues except where fire hazard or threats from diseases and insects are of concern or when other management objectives are best achieved through burning.

Prescribed burning may be used when conducive with management objectives and recommended by IL DNR Forester or forestry certified Technical Service Provider (TSP) to:

- remove undesirable hardwoods
- reduce fuel build-up
- expose mineral soil for improved germination
- adjust community structure and composition

Follow NRCS CPS Code 338, Prescribed Burning. Prepare a prescribed burn plan, consistent with (IL Job Sheet 338 – Prescribed Burn Plan).

For forestland and woodland communities, protect the area from domestic livestock grazing. See NRCS CPS Code 472, Access Control, for further guidance. Controlled and infrequent 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.

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Comply with State best management practices for water quality.

Additional Criteria to Improve and Sustain Forest Health and Productivity

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 and objectives, can occur at 10-15 year intervals.

Follow these general steps in developing a prescription for increasing quantity and quality of forest products:

- Determine existing conditions of the management area by a detailed forest inventory consistent with Section (5.) of the Illinois Forest Management Plan (IFMP) outline.
- Determine owner objectives and resources for achieving desired forest products.
- Based on owner objectives, design a Silvicultural system and appropriate management techniques to achieve objectives.
  For Illinois hardwoods, applicable systems of silviculture include:
  - Single tree selection: Uneven-aged (all-aged) management and volume control of the forest (favors shade tolerant species).
  - Group selection: Even-aged silviculture with uneven-aged management and volume control of the forest.
  - Regeneration harvest: Even-aged silviculture with area control. Modifications include shelterwood and seed-tree methods.
- Mark trees for the desired treatment.
- Examine and evaluate the residual stand after treatment for desired future condition, growth, and development and/or regeneration success.

For even-aged stands with adequate trees of favorable species, potential quality and an average DBH of 6 inches or more, the following table can be used as a guide for residual stocking after thinning:

Avg. Stand Diameter (inches)	Target Spacing (feet)	Basal Area (sq. ft.)	Trees/Acre (number)
Hardwoods			
6	13	51	258
8	16	59	170
10	19	66	121
12	23	71	83
Pine			
6	12	59	304
8	14	78	222
10	16	93	170
12	18	106	135

Keep improvement thinning in hardwoods 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.

Strip or row thinning is possible in plantations with straight rows. A typical row thinning will remove one-third of the stand or every third row.

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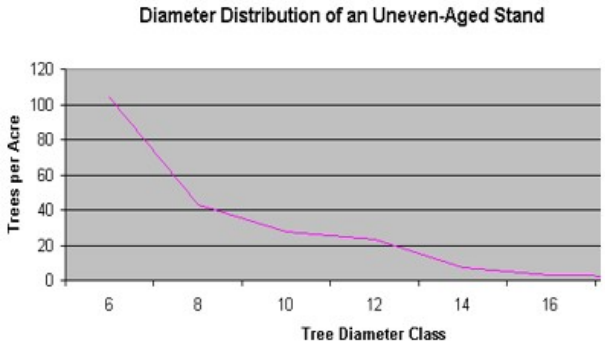
For uneven-aged (all-aged) stands, create or maintain age classes which occupy an equal amount of ground space per acre. Each improvement activity should:

- 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)



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

- 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' crowns.

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

For optimal productivity of even-aged and uneven-aged hardwood stands in Illinois, utilize "Recommended Silviculture and Management Practices for Illinois Hardwood Forest Types" in plan and specifications development for the appropriate forest site type.

Crop Tree Management:

Select and mark/flag 20 to 75 crop trees per acre based on the following criteria:

- dominant or codominant canopy tree
- healthy crown
- seedling origin or stump sprout at < 6"
- minimal epicormic branching
- good form
- free of defects and disease
- desired species
- adapted species

Landowner objectives and stand quality may result in as few as 5 to 20 crop trees released per acre, but never more than 100 trees per acre.

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After selecting and marking crop trees, remove all trees in direct adjacent competition with the crop trees' crown. It is not necessary to cut or kill trees that are overtopped unless it is a large shade tolerant tree (sugar maple, basswood, beech) that may grow up into the crown of the crop tree. Provide at least 10 to 15 feet of crown growing space on all sides of residual crop trees.

See Illinois Forestry Technical Note – Crop Tree Management (TN1-IL666CTM) for further guidance.

Treatments, including woody biomass removal, will be sustainable and will not compromise soil organic matter, the recruitment and retention of coarse woody debris, or wildlife habitat. If needed, use NRCS CPS 384, Woody Residue Treatment. If applicable, use biomass harvesting guidelines (The Forest Guild, 2010) and/or State guidance.

Manipulate stand characteristics to mitigate risk of insects and disease. Examples of stand manipulations include creating a diversity of tree species and a mosaic of age classes.

Additional Criteria to Reduce Fire Risk and Hazard and Facilitate Prescribed Burning

Reduce stocking rates and alter spatial arrangement of trees to minimize crown-to-crown spread of fire. 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.

Use criteria for wildfire risk and damage reduction, including reduction of ladder fuels, in NRCS CPS Codes 384, Woody Residue Treatment or 394, Firebreak, as appropriate.

Additional Criteria to Improve Wildlife and Pollinator Habitat

Manage for specific or a variety of cover types, species, size-classes, and stocking rates at the appropriate scale that meet desired wildlife habitat requirements and natural community needs.

Create, recruit, and maintain sufficient snags, nest, cavity, and den trees, and down woody material to meet requirements of desired species.

Wildlife as a Primary Objective:

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

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

Leave 4 to 6 vines per acre. Favor trees with vines that will be left as den trees and trees not considered crop trees for the secondary purpose of forest products.

Low intensity prescribed fires may be used to improve/increase green browse for wildlife. Refer to NRCS CPS Codes 338, Prescribed Burning for additional guidance. A prescribed burn plan, consistent with (IL Job Sheet 338 – Prescribed Burn Plan or approved alternative), will be prepared.

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

- Downed Tree Structure
- Edge Feathering
- Wildlife Brushpiles

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 and trees not

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considered crop trees for the purpose of forest products.

Refer to habitat creation and maintenance criteria in NRCS CPS Codes 647, Early Successional Habitat Development/Management; Code 643, Restoration and Management of Rare and Declining Habitats; Code 649, Structures for Wildlife; Code 645, Upland Wildlife Habitat Management; or Code 644, Wetland Wildlife Habitat Management, as appropriate, to manage wildlife-related activities.

Additional Criteria to Alter Quantity, Quality, and Timing of Water Yield

Create a mosaic of age classes to increase water yield and stabilize seasonal water yield from watersheds.

Create openings in the forest canopy to allow more light to reach the ground, stimulating understory vegetation and diversifying plant species composition and vertical structure. These improvements will increase rainfall infiltration and reduce runoff, thereby reducing soil erosion and improving water quality.

Additional Criteria to Increase Carbon Storage

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

CONSIDERATIONS

Considerations for Improving and Sustaining Forest Health and Productivity

Consider crop tree management (Perkey et al. 1994) when making decisions about which trees to retain and which to cut or kill.

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

Consider enlisting the assistance of a professional forester when seeking to rehabilitate degraded stands that have been repeatedly subjected to exploitative harvesting (high-grading). Often a complex site-specific treatment plan must be developed to overcome repeated exploitative timber harvest.

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

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

Consider retaining at least 1/4 to 1/3 of the slash, tops, and limbs after harvest to protect site productivity. When using whole-tree harvesting systems, minimize the removal of needles or leaves by harvesting in the dormant season, retaining fine woody materials onsite, or leaving felled trees onsite to allow for needle or leaf drop.

Consider controlling invasive plants if they are encountered while conducting forest stand improvement. Use NRCS CPS Codes 314, Brush Management; or 315, Herbaceous Weed Control, as appropriate.

When available, report the minimum criteria (diameter at breast height, log length, etc.) for commercial forest products (sawtimber, pulpwood, etc.) in order to know when to direct a client to a professional forester.

Consider advising landowners to secure a written contract with a 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.

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Landowners planning to sell timber should: know the amount of timber to be sold through an inventory, receive sealed bids, obtain a signed contract with an Illinois licensed timber buyer, receive full payment before cutting begins, and supervise harvest operations. For further information and sample contracts, see Here's How to…Write an Iron-Clad Timber Sale Contract in References.

Considerations for Wildlife and Pollinator Habitat

State Wildlife Habitat Evaluation Guides and Biology Technical Notes are useful tools in planning forest stand improvement.

Consider removing vines from crop trees but retaining vines with wildlife value (e.g., grape and poison ivy) on non-crop trees.

Increase quantity and quality of important mast (seeds, catkins, fruits, and nuts) sources for wildlife through crop tree management and other techniques.

Improve horizontal diversity or patchiness (of different age class units) across the forest for a variety of wildlife.

Improve or maintain vertical structure or vegetative layering in treated stands.

Favor declining wildlife species by providing appropriately sized treatment areas or blocks of habitat.

Time forest stand improvement activities to minimize disturbance of seasonal pollinator and wildlife activities, such as nesting, movement, etc.

Considerations for Increasing Carbon Storage

To increase carbon storage, consider shifting from even-aged to uneven-aged management to increase the retention of carbon onsite. Use regeneration methods that encourage advanced regeneration and retention of mature trees, such as shelterwood, to retain carbon onsite for longer periods. Consider retaining snags and downed woody debris for additional onsite carbon storage, and adopt techniques for maintaining soil quality, including organic carbon retention.

To grow trees that can store carbon in durable manufactured products, consider lengthening rotations to retain mature trees longer and grow to larger sizes. Consider using crop tree management techniques (Perkey et al. 1994) to concentrate growth on suitable long-lived species.

Considerations for Visual Quality

When forest stand improvement is used to improve visual quality, consider leaving trees that are attractive in shape and structure or flower and are appropriate to the site, especially around structures, roads, and home sites.

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
- releasing crop trees with unique or desirable characteristics (attractive flowers, colorful foliage, unique form or bark, etc.)

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PLANS AND SPECIFICATIONS

Plans and specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, implementation requirements (job sheets), technical notes, and narrative statements in the conservation plan, or other acceptable documentation. Clearly state the goals and objectives of the forest stand improvement. Specific stand-stocking guidelines will clearly document both the pre- and post-treatment stand condition. Refer to JS-IL666

A current and fully prepared *Illinois Forest Management Plan (IFMP)* will provide complete specifications and serve as an appropriate plan of operations.

Review: (1) *NRCS Bald Eagle Habitat Conservation Guidelines for Illinois, and (2) NRCS Forest Stand Improvement and Prescribed Burning Conservation Measures for Indiana, Gray and Northern Long-Eared Bats in Illinois,* during planning and prior to tree cutting and/or prescribed burning activities.

Current versions of these documents are located in Section II of the Illinois Field Office Technical Guide.

OPERATION AND MAINTENANCE

Review and provide the operator all applicable operation and maintenance measures to maintain the conservation practice throughout the intended lifespan.

Periodic inspections during and after treatment activities are necessary to ensure that intended objectives are achieved and resource damage is minimized. As a minimum, include inspection of insects, disease and other pests, storm damage, and damage by trespass. Determine the need for additional treatment under this practice from the inspection results.

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