Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

FOREST STAND IMPROVEMENT

CODE 666

(ac)

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
- 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

Use of this standard requires compliance with all applicable federal, state, and local laws and regulations. Describe the extent or size and orientation of treatment area(s).

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. 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. Stocking will be described in terms of crop trees per acre, basal area per acre, trees per acre, between-tree spacing, or by any other appropriate and professionally accepted density or stocking protocol.

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

Selected method(s) for vegetation control will be appropriate to the target species. Competing vegetation will be controlled by using the following method(s) and appropriate herbicides as necessary to obtain satisfactory control: cutting, girdling, frilling, stem injection, basal bark spray, foliar spray, soil application, and prescribed burning. Refer to the Indiana (IN) Field Office Technical Guide (FOTG) Forestry Technical Note Forest Stand Improvement Treatment Methods.

Herbicide application following mechanical cutting, girdling, and frilling will increase mortality and reduce stump sprouting. Refer to WIN-PST criteria in IN FOTG standard (595) Integrated Pest Management, and comply with applicable State and local laws if herbicide will be used.

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 IN FOTG standard (655) Forest Trails and Landings, to protect soil and site resources from vehicle impacts.

Use IN FOTG standard (560) Access Road for more heavily used roads associated with forest stand improvement activities.

Protect woodlands from grazing livestock except as part of a grazing plan, forest management plan, or wildlife management plan to facilitate removal of undesirable understory vegetation for the restoration of native plants, as approved by a professional forester or biologist. See IN FOTG standard (472) Access Control for further guidance.

Where slash and debris will be generated, 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. When slash and other debris will be burned onsite use IN FOTG standard (338) Prescribed Burning.

Comply with Indiana Department of Natural Resources best management practices for water quality.

Additional Criteria to Improve and Sustain Forest Health and Productivity

To improve and sustain forest health, 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.

Improvement cuttings for productivity will be light enough (maintaining at least 60% stocking) to restrict the growth of undesirable species, to maintain full site utilization, and to reduce epicormic branching and basal sprouting.

Strip or row thinning is possible in plantations with straight rows. Remove the desired number of rows to maintain health and productivity (typically every other to every third row).

In general 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 crown (3 to 5 feet growing space in young high valued stands).

For even-aged stands with an average diameter at breast height (DBH) of 6 inches or greater, use the following tables as a guide for minimum residual stocking after thinning:

Average Stand Diameter (inches)	Spacing (feet)	Basal Area ($ft.^2$)	Trees Per Acre (no.)
Hardwood Species			
6	13	55	258
8	16	60	170
10	19	65	121
Pine Species			
6	12	60	304
8	14	75	222
10	16	90	170

Crop Tree Management (CTR)

- Commercial use and local demand will determine what species are considered crop trees.
- Select 20 to 75 crop trees per acre. Final crop trees may result in as few as 10-20 crop trees per acre. Young stands can hold a maximum of 60 to 100 crop trees per acres. Older stands will hold far fewer crop trees per acre.
- Select crop trees based on the following criteria: Dominant or codominant canopy tree, stump sprout at <6" (if applicable), healthy crown, minimal epicormic branching, good form, free of defects and disease, desired species, and adapted species.
- Crop Trees will be released on all sides. Any competitor whose crown touches that of the crop tree should be eliminated (typically 8 to 15 feet released). Release of three sides can be used for 10 to 13 inch DBH crop trees, to limit the risk of epecormic branching where timber quality is a concern. In high-risk locations, such as young stands of high value, release can be done on at least 2 sides when crop trees are 2 to 5 inches in DBH with 3 to 5 feet of growing space.
- All detrimental vines greater than 1 inch in diameter in the crop trees canopy will be controlled using appropriate methods.

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

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

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 applicable, use Indiana Department of Natural Resources, *Harvesting Biomass: A Guide to Best Management Practices*.

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 Initiate Forest Stand Regeneration

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

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

Refer to the IN FOTG Forestry Technical Note Forest Stand Improvement Treatment Methods.

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.

Use criteria for wildfire risk and damage reduction, including reduction of ladder fuels, in IN FOTG standard (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.

Use habitat creation and maintenance criteria in IN FOTG standards (647) Early Successional Habitat Development/Management, (643) Restoration and Management of Rare and Declining Habitats, (649) Structures for Wildlife, (645) Upland Wildlife Habitat Management, and/or (644) Wetland Wildlife Habitat Management, as appropriate to manage wildlife-related activities.

Additional Criteria to Increase Carbon Storage

Manage for tree species and stocking rates that have higher rates of growth and potential for carbon sequestration. Refer to Conservation Tree/Shrub Suitability Groups in Section II. of eFOTG to determine trees to manage.

CONSIDERATIONS

The considerations section contains information that is optional to the planner.

Consider utilizing a professional forester to mark and oversee the progress of the Forest Stand Improvement. Particularly 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.

Consider crop tree management (Perkey et al. 1994), or IN FOTG Forestry Technical Note Forest Stand Improvement Treatment Methods when making decisions about which trees to retain and which to cut, kill cut, or kill.

If available use sanitation-salvage and risk-rating criteria to determine trees to remove during forest stand improvement operations (see Thinning and Sanitation in Donaldson and Seybold 1998).

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, such as prescribed burning, site preparation, tree and shrub establishment, prescribed grazing, 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 IN FOTG standards (314) Brush Management or (315) Herbaceous Weed control, as appropriate.

When available, report the minimum criteria (DBH, 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.

Considerations for Wildlife and Pollinator Habitat

State Wildlife Habitat Guidelines, Wildlife Habitat Evaluation Guides, and Wildlife Habitat Evaluation Procedure are useful tools in planning forest stand Improvement.

Consider wildlife food and cover needs when making modifications to forest composition and tree spacing. Thin to 60% stocking or less (typically not below 40 BA/acre) to encourage fuller crown development, increase seed production, and promote herbaceous plant development.

Consider removing vines from crop trees but retaining vines with wildlife value (e.g., grape and poison ivy) on noncrop 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; also 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 being 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.

Consider leaving an untreated 30 foot strip of woodland adjacent to open fields, highways, or open water areas to provide wind protection for the woodland, prevent hazardous tree from falling, and contribute to the aesthetics of the community.

Consider assessing the potential landowner and operator liability before forest stand improvement begins.

PLANS AND SPECIFICATIONS

Plans and specifications for applying this practice will 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 IN FOTG standard (666) Forest Stand Improvement Job Sheet.

OPERATION AND MAINTENANCE

Prepare an Operation and Maintenance plan for the site and review it with the operator. The plan will describe actions that must be taken to ensure that the practice is applied correctly during its design life. As a minimum, include periodic inspections for assessment of insects, disease, and other pests, storm damage, and damage by trespass. Use IN FOTG standard (655) Forest Trails and Landings to control erosion on forest roads, skid trails, landings, and adjacent areas by installing/maintaining vegetative and structural practices. Treatments needed for pests - see Additional Criteria to Improve and Sustain Forest Health and Productivity section in this document. Treatments needed for storm damage - use IN FOTG standard (384) Woody Residue Treatment, to appropriately treat slash and debris. Treatments for damage by trespass: use IN FOTG standard (472) Access Control, to prevent future damage.

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