Michigan Technical Note

USDA-Natural Resources Conservation Service

FORESTRY #25
Subject: Forest Stand Improvement
Date: April 2007

DEFINITION

Forest Stand Improvement (FSI), Natural Resources Conservation Service (NRCS) Conservation Practice Standard 666 is the manipulation of species composition, stand structure, and stocking by cutting or killing selected trees and understory vegetation. Purposes for applying FSI include: increase the quantity and quality of forest products; harvest forest products; initiate forest regeneration; restore natural plant communities; and improve wildlife habitat, visual quality, recreation, and open space values. FSI may be accomplished through a timber sale or it may be non-commercial depending on the size, quality, and/or quantity of trees that need to be removed and the market for forest products. Depending upon the goals and objectives of the landowner, FSI may or may not seek to initiate forest regeneration.

Relationship between FSI and Silviculture

Silviculture has been defined by the Society of American Foresters as the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis. It has also been called applied forest ecology. Included is everything from establishing a forest through regeneration to removing mature timber for forest products or wildlife habitat improvement. FSI implies that there are trees present and that manipulation of the existing trees can produce an improvement in the condition of the residual forest or create conditions that favor

natural regeneration of the forest. FSI is a tool to achieve a silvicultural goal. Other tools for achieving silvicultural goals include tree planting, prescribed burning, pest management, fertilization, and pruning.

Application of FSI

FSI can be applied in what are called "intermediate treatments" that cut or kill undesirable trees but are not directly associated with harvest/regeneration activities. Intermediate treatments are aimed at improving the growth rate, species composition, and form quality of the forest by removing less desirable trees to concentrate subsequent growth on the most desirable trees. Intermediate treatments include weeding, cleaning, several kinds of thinning, and crop tree release. See References for glossaries of forestry terminology.

Crop tree release has become a widely accepted intermediate treatment because it focuses attention on just those individual trees that meet landowner objectives and removes only those trees that compete with crop trees for light. Sunlight has been determined to be the most critical resource for forest trees. Nearby trees that do not contact a crop tree crown, or are growing below a crop tree crown, can be passed over since they do not compete for light with crop trees. Crop tree release has been developed and most widely applied in eastern hardwoods (oak/hickory) where the highest valued species are very light demanding/shade intolerant. It is a relatively simply process of identifying the trees that most closely match landowner goals and objectives, and cutting or killing neighboring trees that compete for light with crop trees. Bottomland hardwoods (elm/ash/cottonwood/silver maple) tend to form overstocked monocultures on lowland, poorly drained soils, and riparian areas. Crop tree release is the best method for diversifying and opening up these stands to allow a more robust understory to develop. Often bottomland hardwood stands are so dense and shaded that bare ground is found in the understory and sites are prone to soil erosion. Opening up the canopy ("daylighting") allows establishment of grasses, forbs, and shrubs which aid in preventing soil erosion and improving water quality, especially in riparian areas. Eastern and bottomland hardwoods happen to be co-located predominantly in the southern one-third of Michigan. An FSI Job Sheet (666-EHB) has been developed specifically for Eastern and Bottomland Hardwoods.

Northern hardwoods (sugar maple/basswood/beech) are very shade tolerant and thrive at higher densities than eastern hardwoods. Pines (red and white) also thrive at relatively high densities and will naturally shed their lower branches at high densities, a desirable outcome for most forest products. Because of the need to assure a relatively high post-treatment density in northern hardwoods and pines, basal area (BA), a measure of stand density, becomes the first consideration in FSI in these forest types. A certain minimum BA must be maintained and only the excess above the minimum is available to be cut or killed. The "cut trees" can then be distributed to achieve release of the best crop trees and approximately uniform between-tree spacing. The concept of crop tree release and the criteria for selecting crop trees can be applied to northern hardwoods and pines, but maintaining adequate stand density comes first. It should be noted also that there are many differences between northern hardwoods and pines in terms of silvics (how trees grow, reproduce, and respond to environmental changes). In the typical application of FSI in Michigan, however, these two forest types are treated in a very similar manner. They also happen to be co-located, predominantly in the northern two-thirds of Michigan. An FSI Job Sheet (666-NHP) has been developed specifically for Northern Hardwoods and Pines.

FSI can also be applied in a harvest/regeneration activity that is designed to regenerate the forest, obtain products and/or income, and achieve some specific ownership objectives such as special wildlife habitat. Commonly used harvest/regeneration cuts include selection, shelterwood, seed tree, and clearcut. See Appendix 2 for descriptions and illustrations of these harvest/regeneration cuts and References for glossaries of forestry terminology.

NRCS Role in FSI

With 58 Field Offices and 113 Field Office employees, NRCS-Michigan has an opportunity to provide significant FSI technical assistance. Two NRCS programs offer financial assistance for FSI: Environmental Quality Incentives Program (EQIP) and Wildlife Habitat Incentives Program (WHIP). Most NRCS employees have had minimal forestry training and it is not reasonable to expect them to offer a full range of forestry technical assistance. An NRCS client who requests assistance in selling timber or a harvest/regeneration activity would appropriately be referred to a public or private sector professional forester. With training and experience in basic tools and techniques, however, NRCS employees can offer an awareness level of technical assistance to Michigan private forestland owners interested in FSI. Most NRCS clients own small tracts of forestland which they hold for purposes other than timber production. Wildlife habitat and recreation are the most frequently expressed goals and objectives for the typical forestland owner seeking technical assistance from NRCS field offices. With a working knowledge of tree identification, crop tree release, and determination of BA, NRCS employees can make their clients aware of the value and potential improvements, including timber improvements, which could be made to their forestlands. NRCS can and should offer both technical and financial assistance for FSI state-wide.

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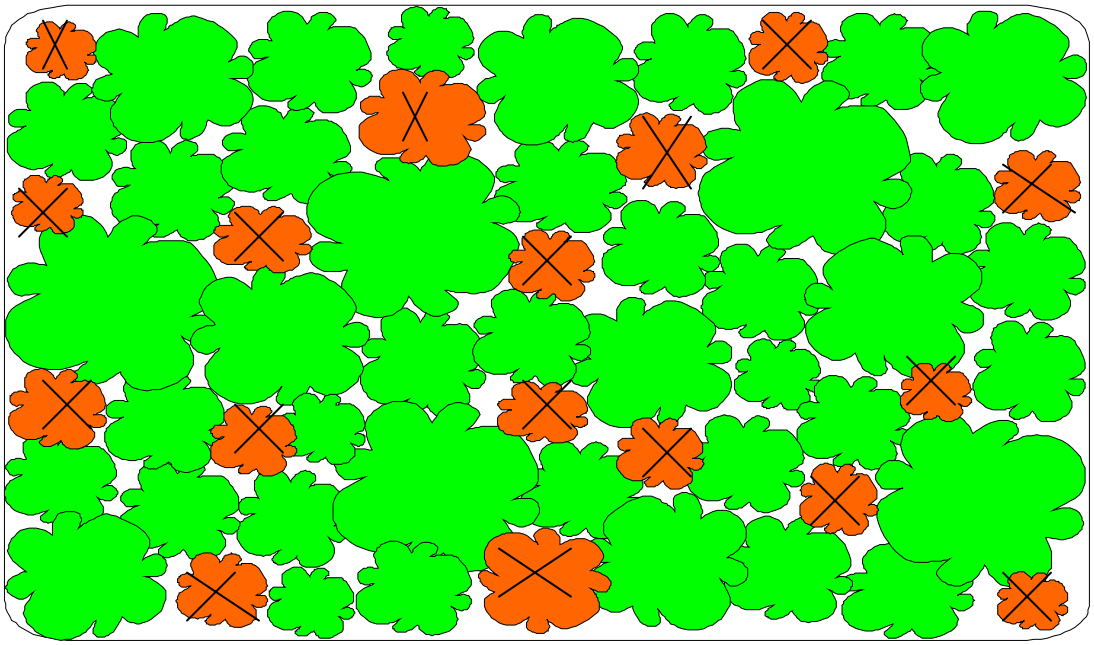
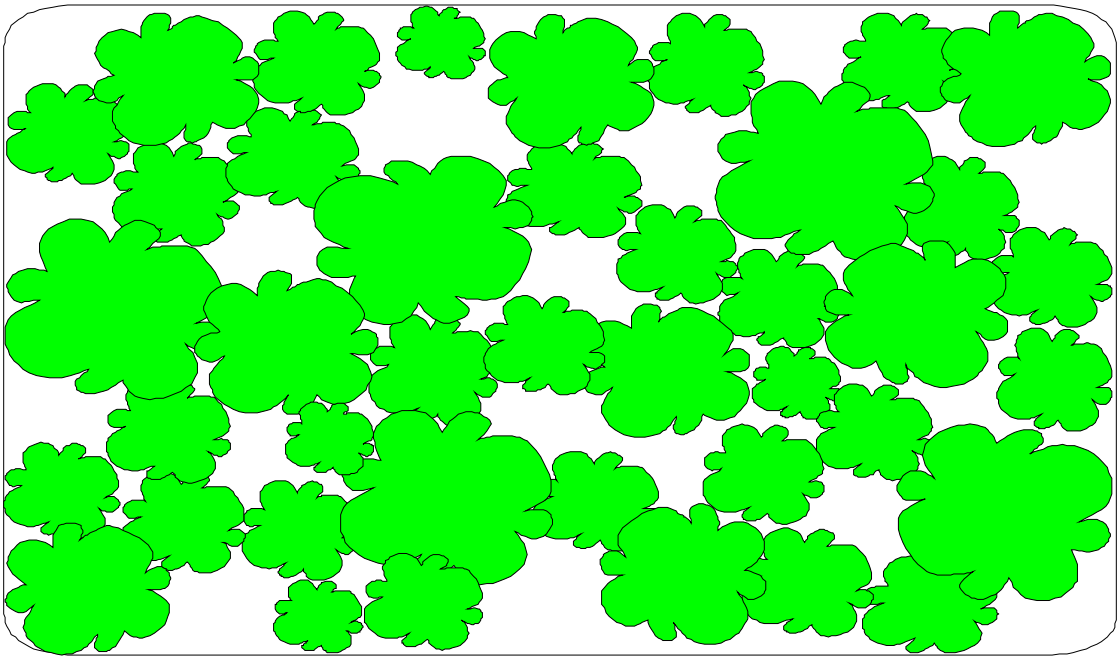
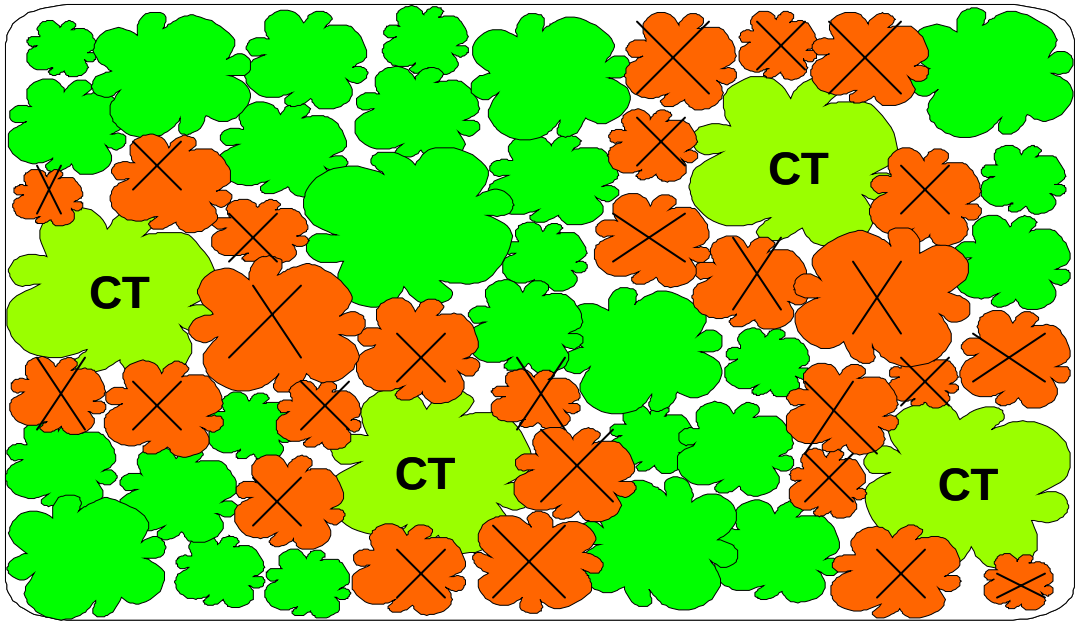
APPENDIX 1. Ways of Applying FSI in Intermediate Treatments



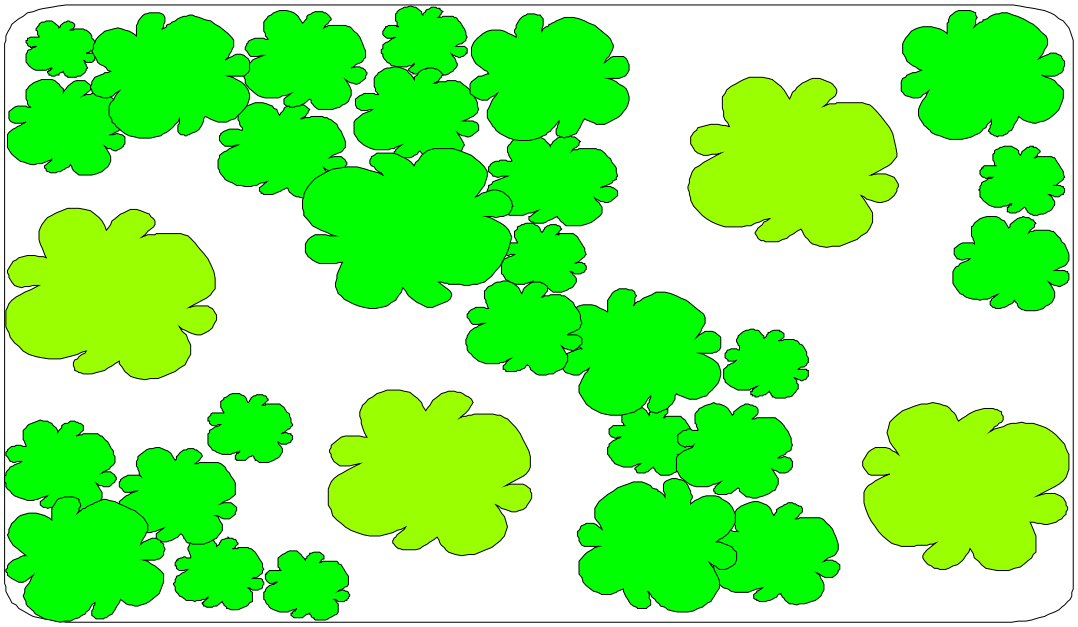
Area-wide thinning, no Crop Trees identified, trees to be cut or killed in red with an “X”.



Area-wide thinning with “cut trees” removed. None of the remaining trees are fully released (on all 4 sides) from surrounding competing trees. This incomplete release is undesirable for eastern and bottomland hardwoods, but may be desirable for shade tolerant northern hardwoods and pines, depending on post-treatment basal area target.



Four Crop Trees have been identified (CT) and competing trees (crown touching trees) are shown in red with an "X" (see Job Sheet 666-EBH for Crop Tree selection criteria).



Competing trees have been removed (cut or killed) and the four Crop Trees fully released. This is ideal for shade intolerant eastern and bottomland hardwoods but basal area may be too low for northern hardwoods and pines, which thrive on higher density and more uniform spacing. Awareness of pre-treatment and post-treatment basal area will guide selection of trees to be cut in northern hardwoods and pines (see Job Sheet 666-NHP).

APPENDIX 2. Harvest/Regeneration Methods (used with permission of Temperate Forest Foundation, illustrations by Ralph Butler, American Forest & Paper Association)

UNEVEN-AGED METHODS

Methods suited to tree species which tolerate shade during the early stages of development. Managing and regenerating forests in an uneven-aged condition requires removal of some trees of all sizes either singularly or in small groups. Two selection harvest systems used to remove merchantable trees, create openings for regeneration, and release saplings and pole-sized trees are single tree selection and group selection.

Single Tree Selection

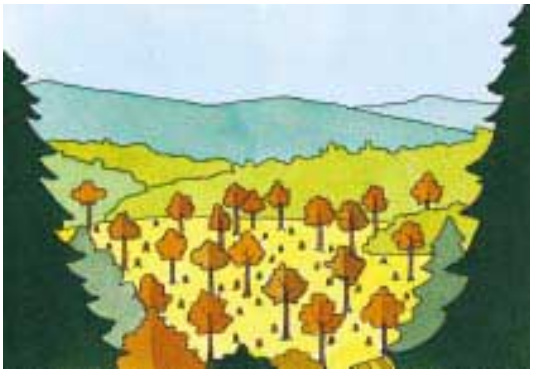
Single Tree Selection - Individual trees of all size classes are removed more or less uniformly throughout the entire stand. Very small openings in the overstory allow a limited amount of sunlight to reach the forest floor. Generally, this system allows regeneration of only the most shade tolerant species like hemlock, beech, and sugar maple.

Group Selection

Group Selection - Trees are removed in small group openings. The maximum width of a group opening may be up to twice the height of the mature trees. Small openings provide sites suitable for some species of fir, spruce, maple, cedar, and hemlock that can regenerate in partial shade. Larger openings that allow more light to reach the forest floor are generally used to regenerate species requiring more light such as oaks, yellow birch, and white pine. With Group Selection, groups are not managed as separate stands. Regeneration, growth, and yield are managed over the entire forest tract.

EVEN-AGED METHODS

Some species of trees are shade intolerant - species which will not tolerate shade during the early stages of development. In order for these species to grow, they require open clearings with no overstory competition. In nature, these pioneer species typically are established after a major disturbance, like a fire, creates an opening for them. Several reforestation systems and harvesting methods can be used to create even-aged stands. While specific treatments vary across the U.S. by tree species and climate, the basic systems are shelterwood, seed tree, and clearcutting.



Shelterwood

Shelterwood - In this method, even-aged stands regenerate beneath the shade provided by mature trees from the previous stand. A typical sequence of treatments can include three distinct types of cuttings: 1) an optional preparatory cut that enhances conditions for seed production; 2) an establishment cut that also prepares the seed bed and provides seed for the new stand; and 3) a removal cut that releases established seedlings and saplings from competition with the overstory. Cutting may be done to leave seed-producing trees uniformly throughout the stand, in groups, or strips. Shelterwoods are sometimes planted to supplement natural seeding. Red and white oak, white pine, and sugar maple are examples of tree species that may be regenerated using the shelterwood harvesting method.

Seed Tree

Seed Tree - This even-aged reforestation method uses mature trees (usually 6 to 15 per acre) from the existing stand to provide seed for regenerating a new stand of trees. Seed trees are typically removed after regeneration is established, but can be retained for wildlife or visual quality objectives. The primary objective of a seed tree regeneration harvest is to provide a natural seed source. As with shelterwood harvests, planting is sometimes used to supplement natural seeding. White pine and several species of oak may be regenerated using the seed tree harvesting method.

Clearcutting

Clearcutting - The removal, in a single cutting, of all overstory trees in a stand to develop a new stand in a shade-free environment; reforestation occurs by natural seeding, direct seeding, planting, or sprouting. Harvest cutting may be done in groups or patches, or in strips. Each individual clearcut area is a unit in which regeneration, growth, and yield are managed. Within clearcuts, certain trees or groups of trees may be left for wildlife, and buffer strips are maintained to protect streams, wetlands, and special areas. Planting or direct seeding are the most commonly used methods of reforestation when using clearcuts, but clearcuts can be designed to regenerate by natural seeding or sprouting from stumps and root suckers. The use of genetically improved seedlings - for increased growth and resistance to diseases and insects - can greatly improve the financial returns of your investment in reforestation. Common tree species regenerated using clearcutting include aspen, jack and red pine, paper birch, and red and white oak.